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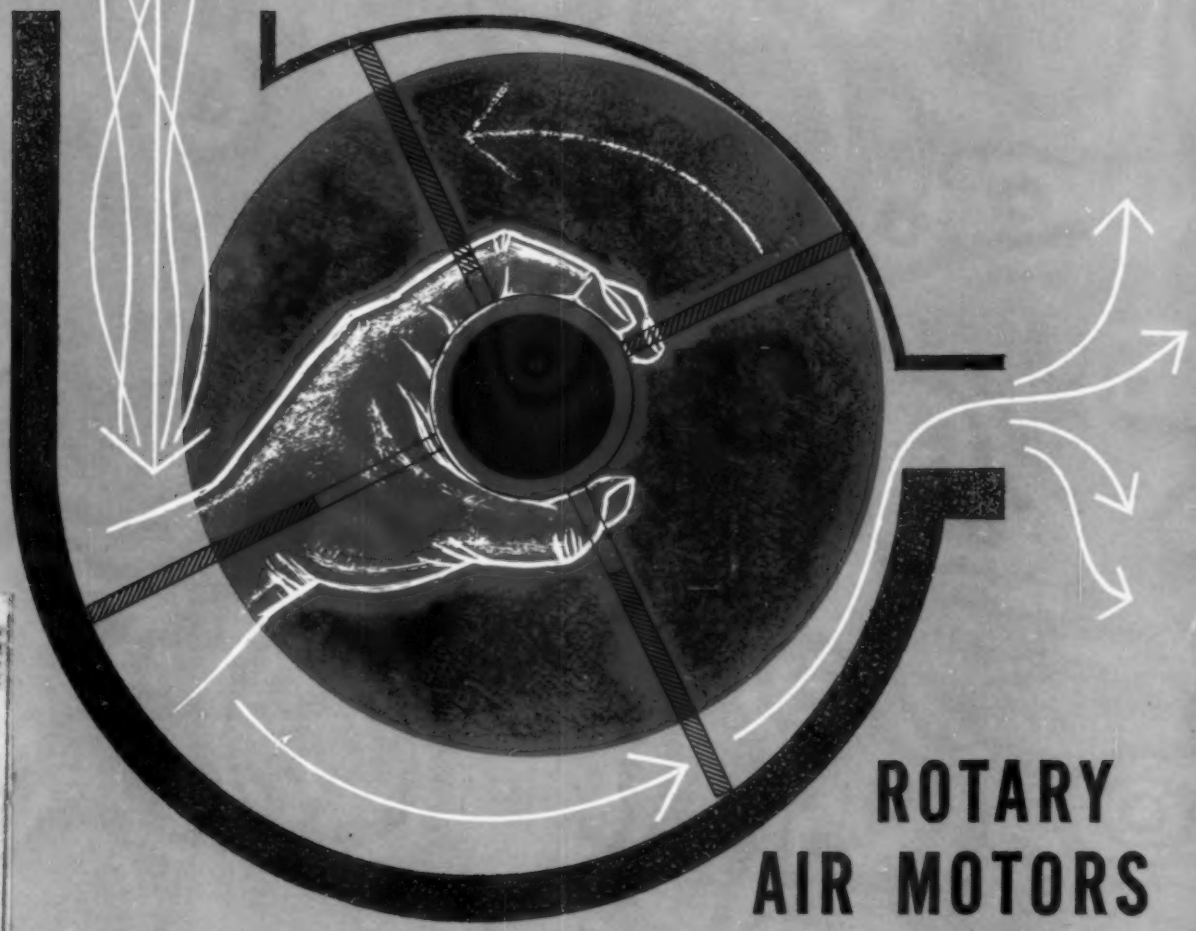
Applied Hydraulics

PNEUMATICS · ELECTRICAL CONTROLS

SEPTEMBER/1957



ROTARY AIR MOTORS

■ their selection.... ■ their application....page 83

STEVENS RICE
UNIVERSITY MICROFILMS
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ANN ARBOR MICH
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THE MAGAZINE OF FLUID POWER

AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

For Advance Information about
THE 1957 HYDRAULICS CONFERENCE
see pages 30-32

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HYDRAULIC FLUIDS
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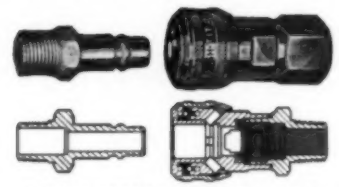
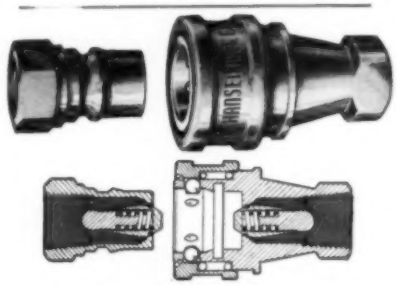


ONE-WAY SHUT-OFF



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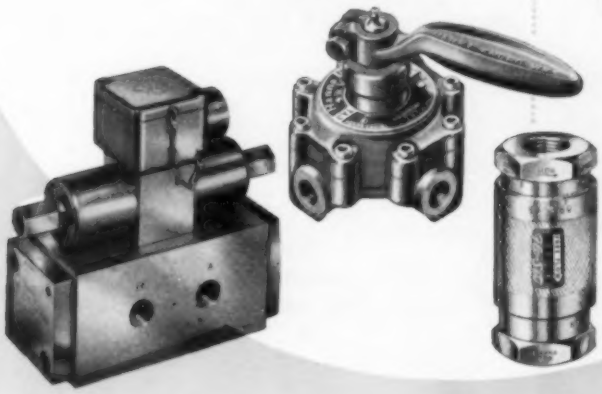

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Applied Hydraulics

Volume 10/Number 9

SEPTEMBER 1957 THE MAGAZINE OF FLUID POWER

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A new interchangeable float design developed by Brooks brings new simplicity and practicality to rotameter instrumentation.

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Applied Hydraulics

THE MAGAZINE OF FLUID POWER

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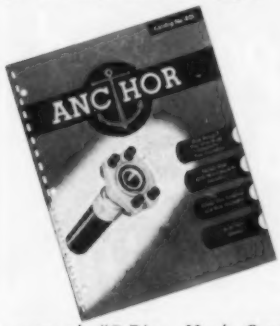
Useful Literature

NEW ANCHOR FLANCO CATALOG ANNOUNCED

A new Anchor Catalog, No. 401, has just been issued that covers Anchor patented FLANCO Hydraulic Hose Assemblies for use with the Anchor FLANCO 4-Bolt, Split-Flange "O"-Ring Head Couplings.



This patented "O-Ring Head Coupling incorporates a leak-proof "O"-Ring seal that eliminates the need for pipe threading, gaskets and sealing compounds. With it connections can be made to valve and pump bosses without wedging by tapered threads. Hose lines can be disconnected and reconnected time after time without leaks because there are no threads to wear out or tapered seats to groove. No special tools are required to connect the FLANCO 4-Bolt, Split-Flange "O"-Ring Head Coupling, -just small automotive type wrenches. Hose assemblies are available for use with this "O"-Ring Head Coupling in Pressed On or Reusable Clamp types for high, medium and low pressure service in sizes ranging from ½" to 3" I.D.

First announced in this catalog is a new Pressed On swivel coupling that offers new freedom in design, positioning and installing of hose assemblies. With 360° swiveling permitted, twisting and straining of the hose is eliminated since it is free to swivel to any desired position.

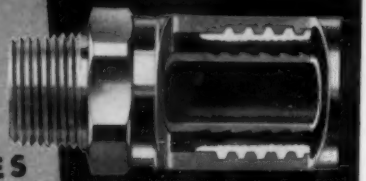
The new swivel coupling is available in all sizes from ½" through 2" I.D. for Two-Wire Braid Hose.

Anchor Pressed On Hose Assemblies for FLANCO 4-Bolt, Split-Flange "O"-Ring Head Couplings are available for high pressure applications in Two-Wire Braid Hose from ½" to 2" I.D., with straight, 22½°, 30°, 45°, 60°, 67½° and 90° couplings. Spiral Wire Suction Hose assemblies are available from ¾" to 2½" I.D. in the same range of angles. Hose assemblies with Clamp-Type Reusable Couplings are available for ½" to 2" I.D. High Pressure, Two-Wire Braid Hose—½" to 2" I.D. One-Wire Braid Hose—¾" to 3" I.D. Spiral Wire Suction Hose,—½" to 1¼" I.D. Medium Pressure HI-BURST 2-Rayon Braid Hose and ½" to ¾" I.D. Low Pressure 2-Rayon Braid Hose, all with coupling stems from 0° to 90° in all standard angles.

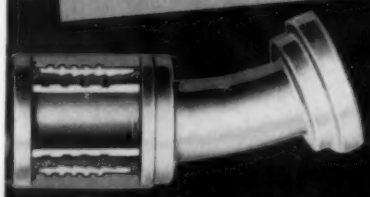
Maximum flexibility and convenience are provided with either the Pressed On or Clamp-Type Reusable Couplings.

Write for Catalog No. 401 to Anchor Coupling Co. Inc., 357 N. Fourth St., Libertyville, Ill.

This Inside Story tells you why ANCHOR® HOSE ASSEMBLIES Meet Your Most Rigid Requirements



ANCHOR HIGH PRESSURE DUCTILE SLEEVE COUPLING TWO WIRE BRAID HOSE ASSEMBLY

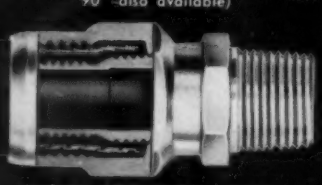


ANCHOR FLANCO BENT STEM 22½° HIGH PRESSURE TWO WIRE BRAID HOSE ASSEMBLY (30°, 45°, 60°, 67½° and 90° also available)

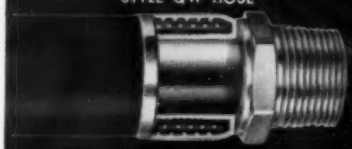
When we speak of "inside story" in this case, we primarily refer to the cross-sectional views shown which obviously confirm both design and construction advantages built into all Anchor Hose Assemblies.

But, further and beyond these obvious benefits, we also refer to the intangible advantages evolving from years of experience in the designing and manufacturing of Hydraulic Hose Assemblies—advantages that can only be verified by actual usage—advantages that do not show up until you reach those bonus months of dependable service, which all users of Anchor Assemblies KNOW about and keep coming back for, order-after-order.

Anchor Hydraulic Hose Assemblies are made in many styles for high, medium and low pressure service, for use on virtually any type of equipment employing a hydraulic system. Maximum working pressures range from 100 PSI in the 2" I.D. spiral wire assemblies to 7,000 PSI in 3/16" I.D. 3-wire braid assemblies. A wide variety of coupling styles are available to suit the requirements of your specific installation.



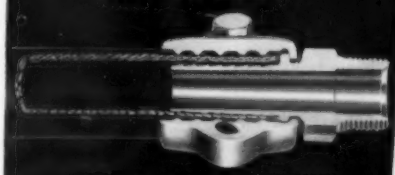
ANCHOR COMMERCIAL "DULOC" REUSABLE COUPLING ON STYLE QW HOSE



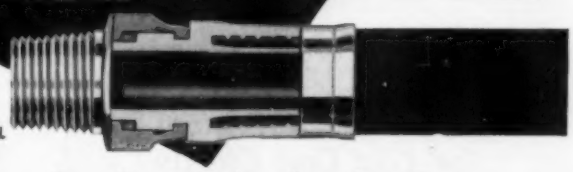
MAX-FLO SUCTION HYDRAULIC RETURN LINE ASSEMBLY

Andy Anchor Says:

Take the first important step to acquaint yourself with Anchor Hose Assembly quality, if you are not already using them—write for Catalog No. 57S giving detailed specifications on high, medium and low pressure hydraulic assemblies. Request Catalog No. 57S—NOW!



ANCHOR CLAMP TYPE REUSABLE COUPLING USED ON TWO WIRE BRAID HIGH PRESSURE HOSE



MAX-FLO ONE WIRE BRAID MEDIUM AND LOW PRESSURE HOSE ASSEMBLY WITH SWIVEL MALE COUPLING

ANCHOR COUPLING CO. INC.

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Branch Offices: Dallas, Tex.; Plymouth, Mich.

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WEBSTER'S NEW PILOT OPERATED RELIEF VALVE

Compact design adapts to "tight" installations. Adjustable from 500 to 2000 psi. Maximum capacity, 20 gpm.

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OIL HYDRAULICS DIVISION

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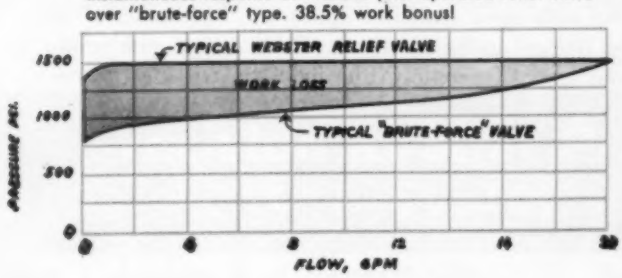

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—Please send the following:

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Fluid Power Lines

about Applied Hydraulics

UP-TO-DATE WINDMILLS . . . Perhaps they're not as picturesque as the white-winged windmills of the Netherlands, but today's air motors are extremely useful, and a lot smaller. Among the more interesting things AH learned about air motors in preparing this issue's lead article is that they will almost literally go through h . . . and high water. Neither heat, within reason, nor total immersion, faze them, as long as they get enough of that nice, cool compressed air. In addition to this, the article, which starts on page 83, contains all kinds of other useful information on air motors: how big they are, how fast they'll run, how much power they develop and when you should give serious consideration to using one.

HUT-TWO-THREE . . . Keeping hydraulic cylinders in step is just as important to fluid power people as keeping the troops in step is to a drill sergeant. Many of the methods are as ingenious as the hay foot-straw foot technique. Bob Raymond has come up with one that uses hydropneumatic accumulators to keep an eye on the cylinders and deliver the proper command to get them back in step should they get out of line. March right over to page 88 on the double for this story.

SCRAM . . . is usually defined as: "head for the hills; the dam is busted", or something like that. It seems to us that the gentlemen who applied this term to nuclear reactor controls must have been familiar with this definition because they applied it to what is done when you want the reactor to stop reacting right now because otherwise heading for the hills will be the thing to do. If this all seems confusing, a good explanation titled "Control of Nuclear Reactor Control Rods With an Integral Hydraulic Servo" can be found on page 91. Who says engineering language is dull?

NEW SUIT . . . About 141 pages due east of here you'll find our new-look Aviation Section. Airborne fluid power has received special consideration in APPLIED HYDRAULICS for more than 8 years and we've decided that delta wings and coke-bottle fuselages called for a new design for the Aviation Section. Objectives have not changed. Keeping aircraft hydraulic and pneumatic system people abreast of developments in the field is still our goal.

Along with more attractive appearance, all material of marked interest in that particular field, such as new products and news of people in the industry, will be concentrated in the Aviation Section to make a package of the aircraft material. One point we'd like to make, however, is our feeling that there is probably much of value for the aircraft people in the solutions of industrial hydraulic problems and vice versa. Hope you like our new look.

finest quality!

Precision "O" Ring quality is maintained by over 100 inspections and quality control tests. As a final step, "O" Rings are rigidly inspected to assure "O" Rings that are:

1. Free of flash. 2. True to size. 3. Meet the specifications.

Have a sealing problem? You'll find the answer at Precision. There's a Precision engineer ready to help you with "O" ring specification and with product design.

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PREVENT STICKING of VALVES

.....and other precision working parts

by removing ferrous grit from fluid power systems

USE....

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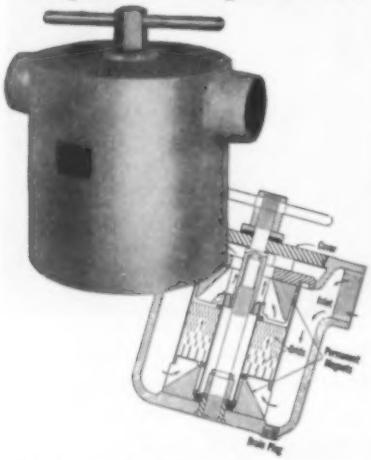
Magnetic Separators



Keep your fluid free of iron contamination—minute particles that can jam in close clearances of working parts. Frantz FERROFILTERS not only extract ferrous particles that make valves stick but take out metallic abrasives which wear and score precisely fitted components causing leakage, misfunction and downtime. For complete information on the application and operation, sizes and capacities of FERRO-FILTERS . . .

Send for BULLETIN PM-65

S. G. FRANTZ CO., Inc.

Brunswick Pike & Kline Ave.
P. O. Box 1138 Trenton 6, N. J.

Fluid Power Lines

continued

ROLL 'EM . . . Thread rolling, or cold forging threads, has become an important machining operation that has advanced because of the application of hydraulics. Although feed rates are critical, high speeds are required. The thread rolling machine described on page 121 has precision movements produced by cylinders.

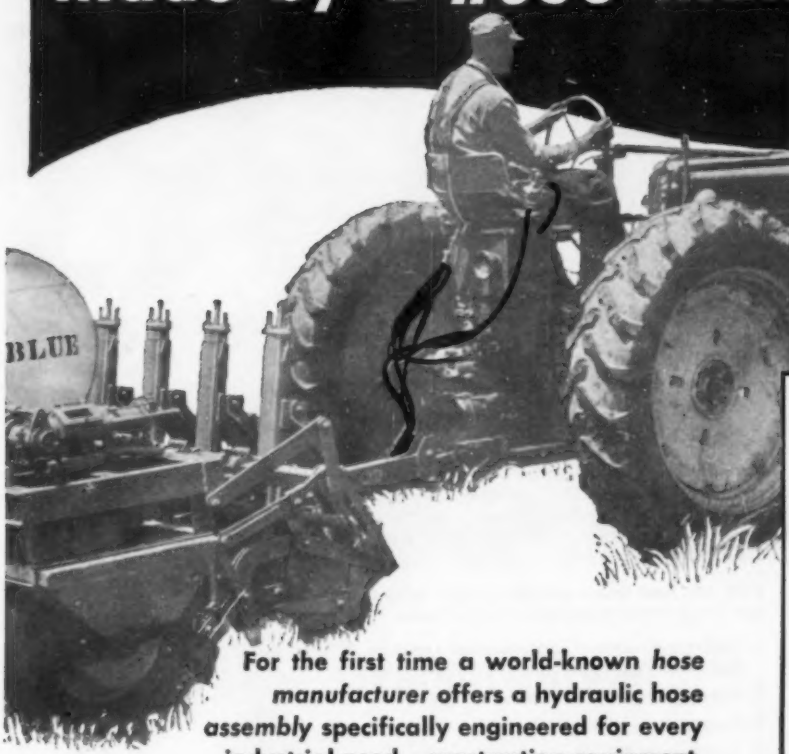
TEXAS . . . is synonymous with bigger and better to some people (Texans.) A few more articles like the one starting on page 105 may convince us that it's so. Hydraulic system using 36 cylinders (lots) to raise man-made island measuring 200 ft on a side (big) and weighing 6000 tons (heavy) 67 ft (high) above the ocean's surface is described in the article. What is this thing? Why, a sho' nuff Texas Tower!

FLUID POWER TAMES ROCK 'N ROLL . . . Continuous rolling of a ship in heavy seas is rarely an aid to digestion. Recently, a solution to this problem, the antiroll system, has been developed. Basically, the system consists of two airfoil-shaped fins extending from the sides of a ship below the waterline. By properly varying the angle of attack of these "water wings", the side of the ship which tends to go down can be lifted, while the other side is forced downward. Actual tests show such a system can reduce a 20 degree roll to less than 2 degrees. Tremendous forces are needed to position the fins rapidly. This is where hydraulics enters the picture, in case you've been wondering. To find out how the strong arm of hydraulics helps to tame ol' debbil sea, read the story on page 129.

QUICK-CHANGE ARTIST . . . For a long time now, we had thought that an accumulator was a device for storing hydraulic energy. And it still is, let us quickly add. However, we were more than a little surprised to learn that accumulators also make good air and gas compressors if you know how to connect them with a few other necessary components. Many of the answers to how to do this are contained in the article by Larry Winston on page 143.

COMING NEXT MONTH . . . Complete program and abstracts of papers to be delivered at the National Conference on Industrial Hydraulics (*see Briefs*). Also three top award papers in APPLIED HYDRAULICS Prize Paper Contest.

Now... hydraulic assemblies made by a *hose* manufacturer



For the first time a world-known *hose manufacturer* offers a hydraulic hose *assembly* specifically engineered for every industrial need—construction equipment, farm machinery, machine tools, presses, lifts and other hydraulic equipment.

There are two important advantages in buying Gates Hydraulic Assemblies:

1. Gates is able to offer *over-all* quality control.
2. Gates, with a nation-wide engineering and service organization of its own, is in a *unique* position to advise, assist and supply manufacturers of machines, vehicles and equipment which use hydraulic systems.

Call your nearest Gates Engineering Office for help in solving hydraulic hose assembly problems. Quickly available stocks in all principal cities.

The Gates Rubber Company
Denver, Colorado

Gates High Pressure Hydraulic Hose (54MB) meets or exceeds SAE specifications

This smooth-covered, easy-to-keep-clean hose has reinforcing braid of extremely flexible high-tensile wire, made specially for this use. Black, oil-resistant rubber withstands heat, abrasion and weather exposure. Recommended for systems subjected to shock loads and heavy pulsating pressures.

Gates Medium Pressure Hydraulic Hose (19HB)

Same quality construction, but with braided cord reinforcement—more than adequate for the lower pressure applications.

Gates®

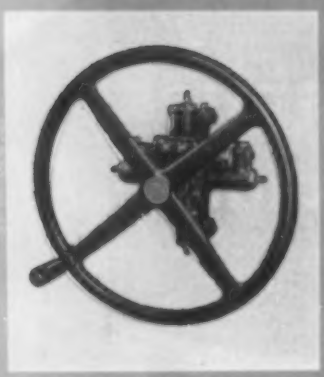
Gates Distributors are in the **Yellow Pages**

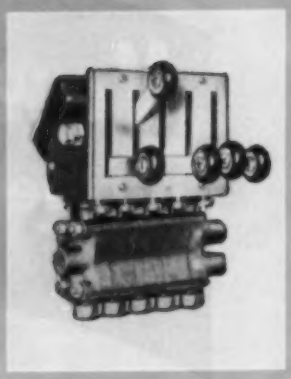
The Mark of *Specialized* Research

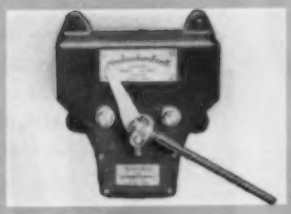
Gates Hydraulic Hose

TPA 193 A

BACKED BY A QUARTER OF A CENTURY OF LOCKHEED HIGH-PRECISION HYDRAULICS







UNITS THAT HAVE MADE HYDRAULIC HISTORY

Lockheed specialized development on the problems of specific industries has led to the evolution of the many units which are ideal for their particular purposes.

The units illustrated are typical of such specialization and represent the basis of the Lockheed Remote Control System. This was developed primarily for the control of Boiler Dampers and is to be found in the great majority of C.E.A. power stations.

It has also been widely adapted to many other industrial uses where the following features are of value:

1. Centralized control and individual selection of any number of control points.
2. Metered control of selected unit.
3. Instantaneous indication of position of selected unit.
4. Auto-locking of slave cylinder at desired position without need of retaining line pressure.
5. Hand operation in a simple system or as stand-by in the event of power failure.
6. Long life and reliable performance.
7. Low power consumption.

AUTOMOTIVE PRODUCTS COMPANY LIMITED

Shaw Road, Speke, Liverpool, England

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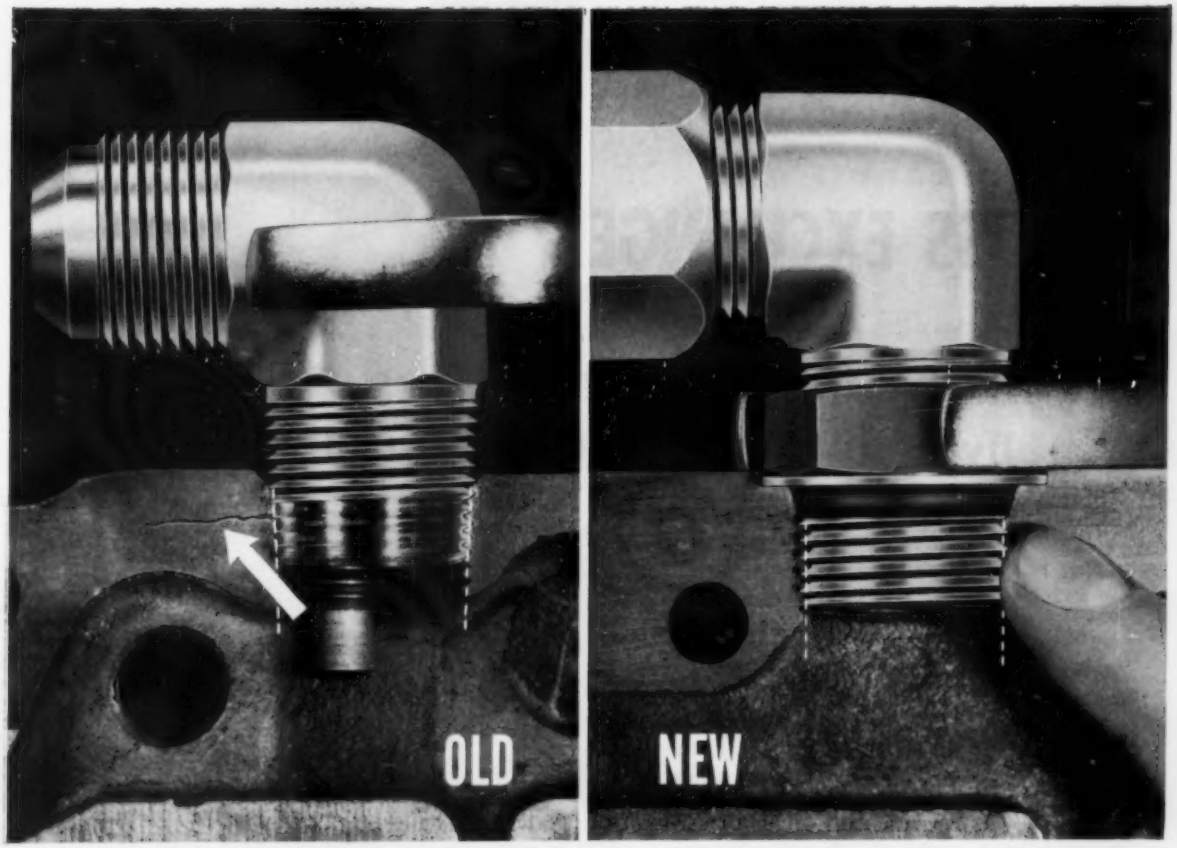
Lockheed

REGD. TRADE MARK

INDUSTRIAL HYDRAULICS

For further details please write for pamphlets, and kindly mention this journal.

COMPLETE INSTALLATIONS BRITISH MADE OR INDIVIDUAL UNITS



How Parker straight-thread fittings solve leakage problems

Forget about danger of cracking or distorting valve bodies by overtightening the fittings. Forget about messy pipe "dope." Forget about leakage problems resulting from tapered pipe threads in high-pressure hydraulic systems.

Eliminate these problems. Use Parker O-ring seal straight-thread fittings (which conform with the SAE Standard for Hydraulic Tube Fittings) for leakproof, trouble-free connections. Available on Parker *Triple-lok* (the industrial standard flare tube fitting) and on Parker *Ferulok* (flareless fitting for heavy steel tubing).

Ask your Parker Distributor today, or mail the coupon for complete information about Parker straight-thread fittings.

New, Broader Line of *Hoze-lok* fittings for medium- and high-pressure hydraulic service. Longer performance, greater re-usability. No skiving of hose. Easier make-up saves time and money.

TUBE AND HOSE FITTINGS DIVISION,
Section 436-B
The Parker Appliance Company
17325 Euclid Ave.,
Cleveland 12, Ohio

Please send:

- ☐ *Triple-lok* Fitting Catalog 4310
- ☐ *Ferulok* Fitting Catalog 4320
- ☐ *No-Skive Hoze-lok* Catalogs 4433 & 4434

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Company_____

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Parker

Hydraulic and fluid system components

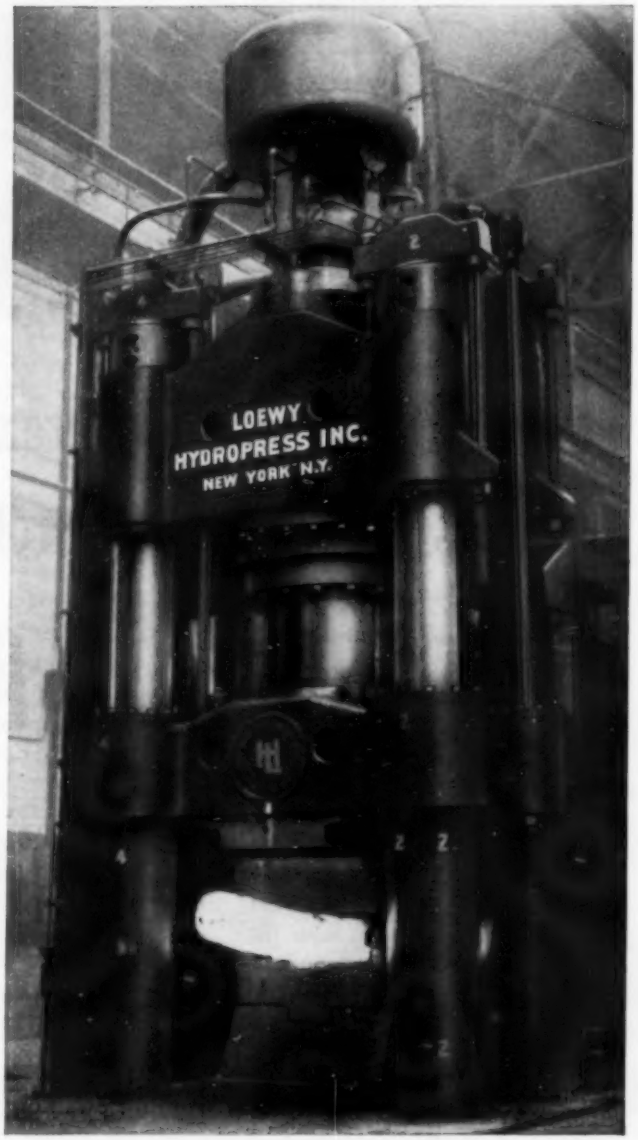
← Circle 17

Circle 114 on Reader Service Card

ROSS EXCHANGER

conditions this Loewy Forging Press to deliver its full, 2000-ton wallop!

Courtesy Loewy-Hydropress Inc., New York



Forging blooms in specialty alloy steels, this Loewy Hydropress slams down its 2000-ton fist with consistent force at high speeds.

To maintain peak capacity of the hydraulic power system, a Ross Type BCF Exchanger was installed as original equipment. Its efficient performance dissipates hydraulic heat, assuring full-rated power at all times. This press is conditioned for the job.

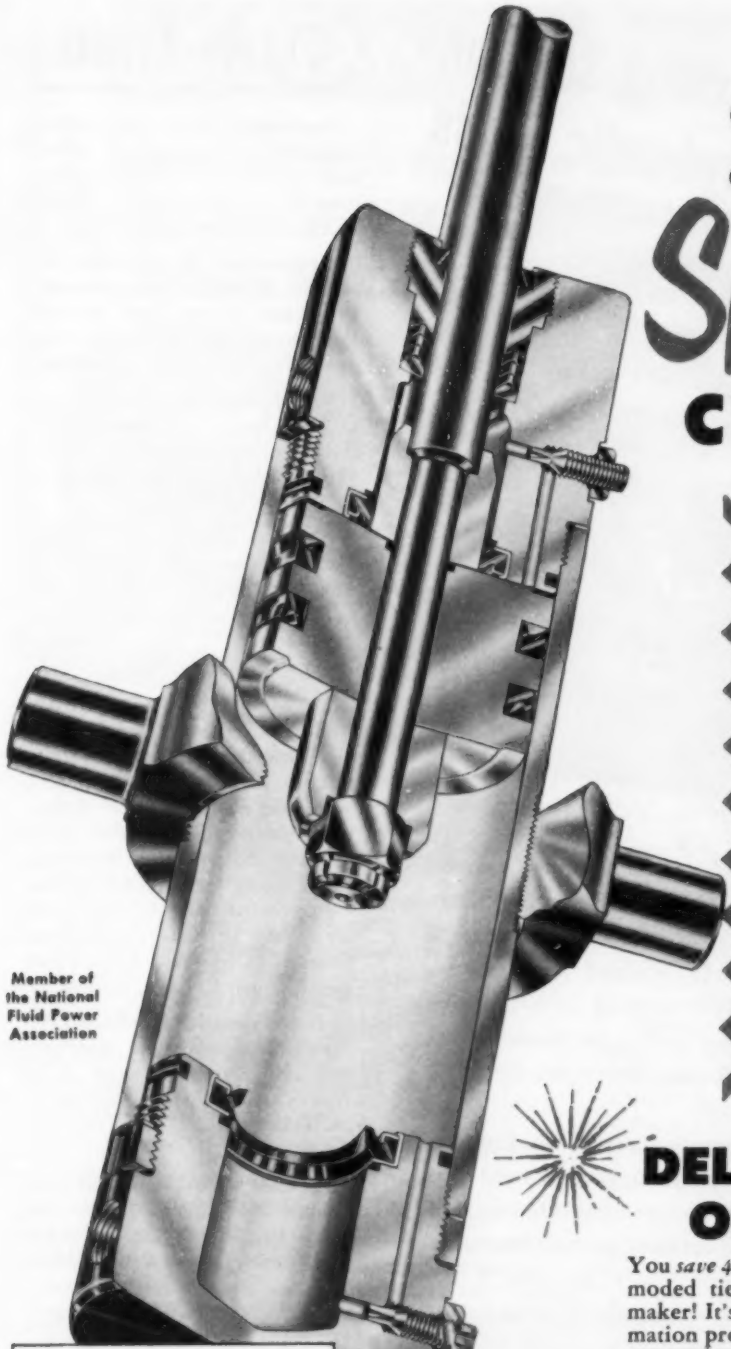
Throughout the industry, Ross Exchangers are favored by numerous manufacturers building hydraulic machinery of every description. There are many solid reasons for this preference, including: (1) *Ruggedness*—The ability to take the punishing shock of sudden hydraulic surges. (2) *Thermal Efficiency*—Unsurpassed by any other heat exchanger design. (3) *Standardization*—Pre-engineered and mass produced parts permit economic manufacture in a wide range of sizes to answer most needs. (4) *Engineering Cooperation*—Ross representatives have a reputation for helpful consultation and practical recommendations.

For detailed information on how Ross Exchangers can help you meet your heat transfer requirements, request Bulletin 1.1K5. Ross Heat Exchanger Division of American-Standard, Buffalo 5, N. Y. In Canada: American-Standard Products (Canada) Limited, Toronto 5, Ont.

ROSS HEAT EXCHANGER

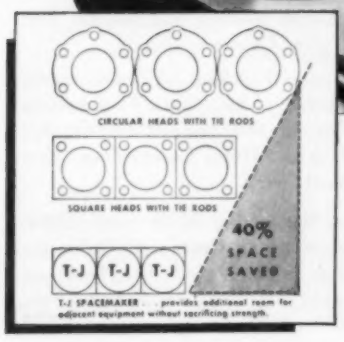
Division of AMERICAN-Standard

all the EXTRAS are standard with T-J Spacemaker CYLINDERS



Member of the National Fluid Power Association

- **NEW** *exclusive* ingenious cushion designs . . . Super Cushion Flexible Seals for Air . . . New Self-Aligning Master Cushion for Oil.
- **STRONGER** than outmoded tie rod design, proven through actual tests. No tie rods to stretch.
- **SOLID STEEL HEADS** throughout the full line.
- **COMPACT DESIGN** eliminates tie rods, increasing the strength and reducing mounting space required, providing extra room for adjacent equipment.
- **HARD CHROME PLATED** body bores and piston rods . . . assure you of long trouble-free service. (Standard at no extra cost.)
- **METALLIC ROD SCRAPER,** not just a wiper, actually removes foreign matter from the rod.
- **PILOTED PACKING GLAND** with extra long bearing. Additional strength and support to the piston rod.
- **OIL** pressure to 750 p.s.i. AIR to 200 p.s.i.


CIRCULAR HEADS WITH TIE RODS
SQUARE HEADS WITH TIE RODS
40% SPACE SAVED
T-J
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T-J SPACEMAKER . . . provides additional room for adjacent equipment without sacrificing strength.

DELIVERY OFF THE SHELF!

You *save 40% space* when you switch from outmoded tie rod cylinders to the T-J Spacemaker! It's stronger, too! Fits right into automation programs in countless plants. Delivers top performance and dependability with a big *plus* in advanced features. Wide range of styles, capacities . . . reduces man-hours and costs in all kinds of push-pull-lift operations. Off-shelf delivery in 64,000 combinations!

NEW LITERATURE—Send today for new Catalog SM56 with complete engineering details on Spacemaker line. Write The Tomkins-Johnson Co., Jackson, Mich.

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RIVETORS · AIR AND HYDRAULIC CYLINDERS · CUTTERS · CLINCHERS

Circle 147 on Reader Service Card

CHEMLON®...the Packing Solution to Non-Flammable Hydraulic Fluids

LASTS LONGER IN ALL HYDRAULIC SERVICES

Once and for all . . . John Crane Chemlon Piston Cup, U-Cup and Flange Packings are the answer to handling *all* types of hydraulic fluids. Molded from chemically inert Teflon*, they give positive sealing and long-lasting performance not possible with leather, fabric-reinforced or similar packings.

Heat will not cause these packings to shrink away from the cylinder walls or rod. They will not harden, shrink, swell or in any way disintegrate under higher temperatures often encountered in hydraulic service. Their exceptional thermal characteristics provide an operating range from −94°F. to +350°F.

Here . . . in a wide range of sizes or fabricated to your individual specifications . . . is a complete line of hydraulic packings to meet the need of any operating requirement.

Write to "John Crane" Send now for bulletin giving full technical and application data. Crane Packing Company, 6405 Oakton Street, Morton Grove, Illinois, (Chicago Suburb). *In Canada, Crane Packing Co., Ltd., Hamilton, Ont.*

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John Crane — MECHANICAL PACKINGS · SHAFT SEALS · TEFLON PRODUCTS · LAPPING MACHINES · THREAD COMPOUNDS

CRANE PACKING COMPANY

Future Events

September 9-13: 12th Annual Instrument Automation Conference and Exhibit of The Instrument Society of America. Public Auditorium, Cleveland, Ohio.

September 30-October 5: SAE Aeronautic Meeting, Aircraft Production Forum and Aircraft Engineering Display. Hotel Ambassador, Los Angeles, California.

October 17-18: The 13th Annual Conference on Industrial Hydraulics. Hotel Sherman, Chicago, Illinois. Raymond D. Meade is Conference Secretary.

October 23-25: Fall meeting National Fluid Power Association, Washington, D. C. For details write: Barrett Rogers, NFPA, 1618 Orrington Ave., Evanston, Illinois.

October 31-November 2: National Conference "Engineering and Scientific Education—Foundation of National Strength", sponsored by the Western Society of Engineers, Engineers Joint Council, the Scientific Manpower Commission, the National Science Foundation and the National Academy of Sciences—National Research Council. Edgewater Beach Hotel, Chicago, Illinois.

November 13-15: Eighth National Conference on Standards and 39th Annual Meeting of the American Standards Association. St. Francis Hotel, San Francisco, California.

January 13-17, 1958: SAE Annual Meeting and Engineering Display, The Sheraton-Cadillac and Statler Hotels, Detroit, Michigan.

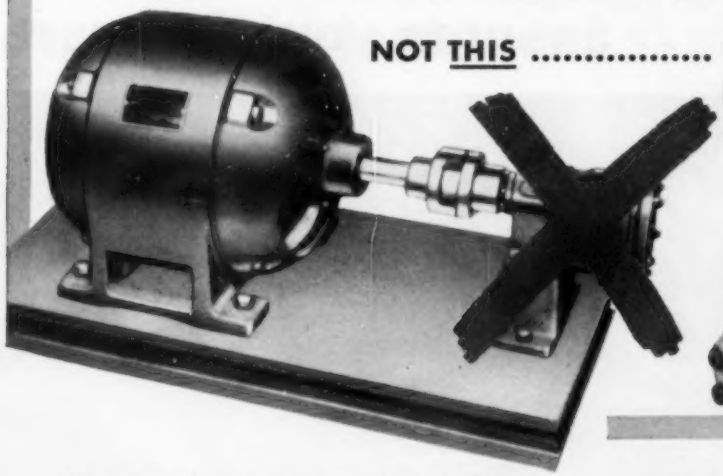
March 31-April 2: SAE Production Meeting and Forum, The Drake, Chicago, Illinois.

April 8-11: SAE Aeronautic Meeting, Aeronautic Production Forum, and Aircraft Engineering Display. Hotel Commodore, New York, N.Y.

May 1-8: ASTE Tool Show, Convention Center, Philadelphia, Pa. For complete information write ASTE, 10700 Puritan Ave., Detroit 38, Mich. ▼▼▼

NOW AVAILABLE!

New TUTHILL Positive Displacement Pump-and-Driving-Motor Units Require Less Space ...Have No Couplings, Adapters or Base



NOT THIS ..... BUT THIS TUTHILL PROMPTLY-DELIVERED SPACE-SAVING UNIT

● Now there are *two* means by which the problems of space, weight, time and cost can be solved in the application of hydraulic, oil burning and lubricating pumps and motors to industrial equipment.

First, the use of compact, custom-built TUTHILL "POWERMITE" pump-and-driving-motor units for original equipment manufacturers having QUANTITY requirements.

Second, the use of compact, standard, promptly-available TUTHILL pump and driving motor units *for individual applications which do not warrant custom design.*

PUMP MOUNTED ON THE MOTOR

Both provide—with no coupling, adapter, or base:

1. **Important savings in space.**
2. **Reduced weight for less shipping and handling costs.**
3. **Fewer components, thus less expense.**
4. **Less assembly time.**

A typical standard TUTHILL pump-and-driving-motor unit is shown above. Note that *the pump is mounted on the motor*...eliminating the need for coupling, adapter and base...and time normally required for their assembly. In comparison with a regular assembly, the new driving unit saves a minimum of 6 inches in space and weighs several pounds less. The TUTHILL rotary positive displacement pumps used in these driving units range in flow capacity from 20-300 GPH and in pressures up to 1500 PSI. The combinations include ¼ HP motors and larger.

...WHICH REDUCES COST AND TIME ($$) TOO

FOR THE OCCASIONAL USER

These latest TUTHILL units extend the advantages of our compact, original equipment design to the occasional user of pump-motor units—the industrial firm interested in individual or minimum quantity orders and prompt delivery.

TUTHILL Positive Displacement motor-and-pump units offer a wide variety of combinations for use in hydraulic, oil burning, lubricating and other services involving many different fluids. The model shown has a capacity of 90 GPH and a ¼ HP motor with a speed of 1750 RPM.

Use the attached coupon—or write TUTHILL PUMP CO.

TUTHILL PUMP COMPANY
981 East 95th Street, Chicago 19, Illinois

Please forward complete information on the new TUTHILL pump-and-driving motor units:

- ☐ for small quantity application
- ☐ for large quantity application by original equipment manufacturer
- ☐ please have your representative call

NAME_____ TITLE_____

COMPANY_____

STREET_____

CITY_____ STATE_____

Tuthill Manufactures a Complete Line of Positive Displacement Rotary Pumps in Capacities from 1 to 200 GPM, for Pressures to 600 PSI, Speeds to 3600 RPM.

TUTHILL PUMP COMPANY

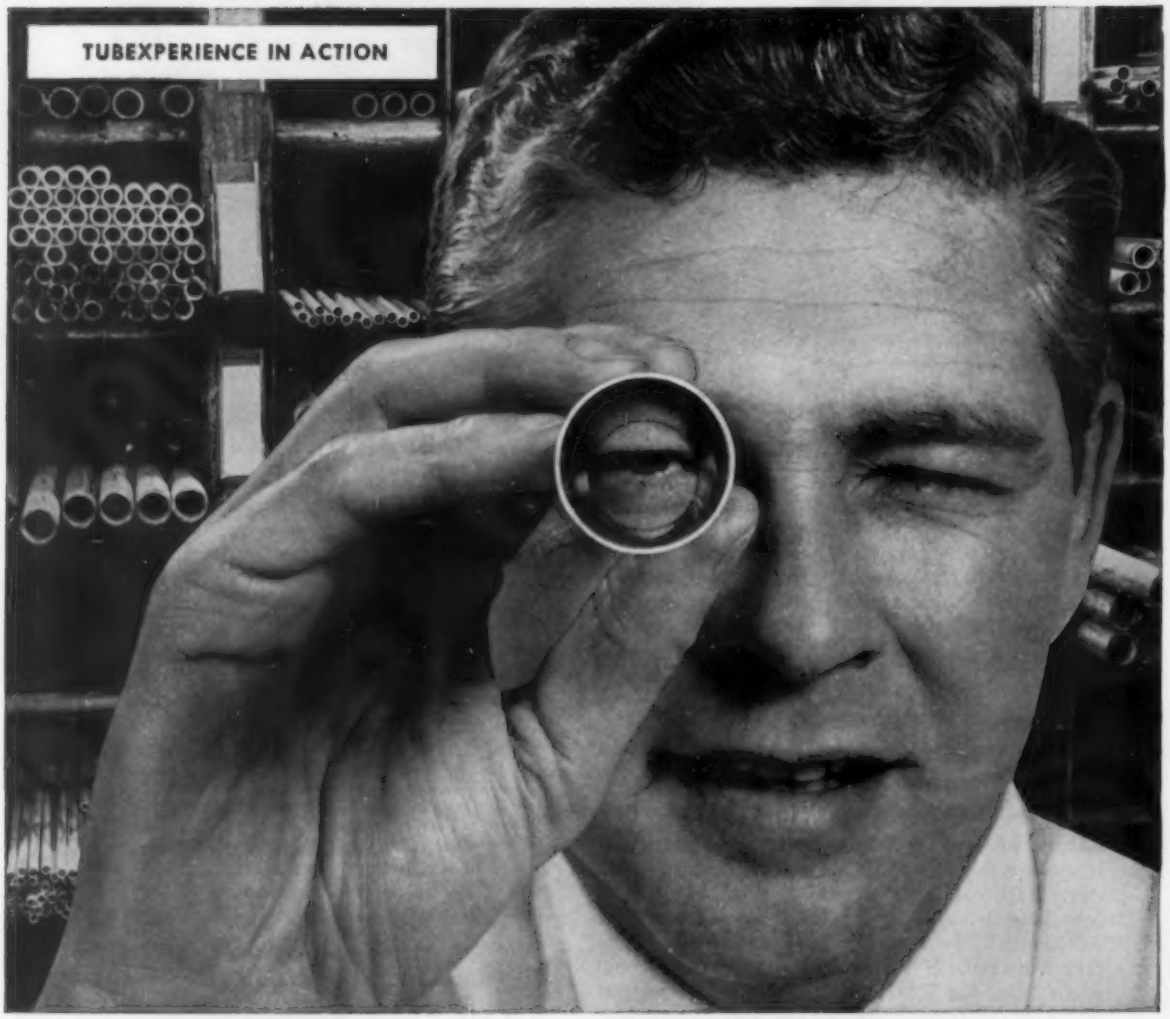
981 East 95th Street, Chicago 19, Illinois
Canadian Affiliate:
Ingersoll Machine & Tool Company, Ltd., Ingersoll, Ontario, Canada

PUMPS FOR YOUR PURPOSE

Your eye tells you why

Superior (SAE)

assures you of a more



BRIGHT!

Take off the rust preventive and just glance at the ID of Superior hydraulic tubing. You'll know you've never seen hydraulic tubing with a brighter finish!

SMOOTH!

You can see this tubing is more than just extra-bright. It's really *smooth*—reduces turbulence and pressure drop in any hydraulic system.

CLEAN!

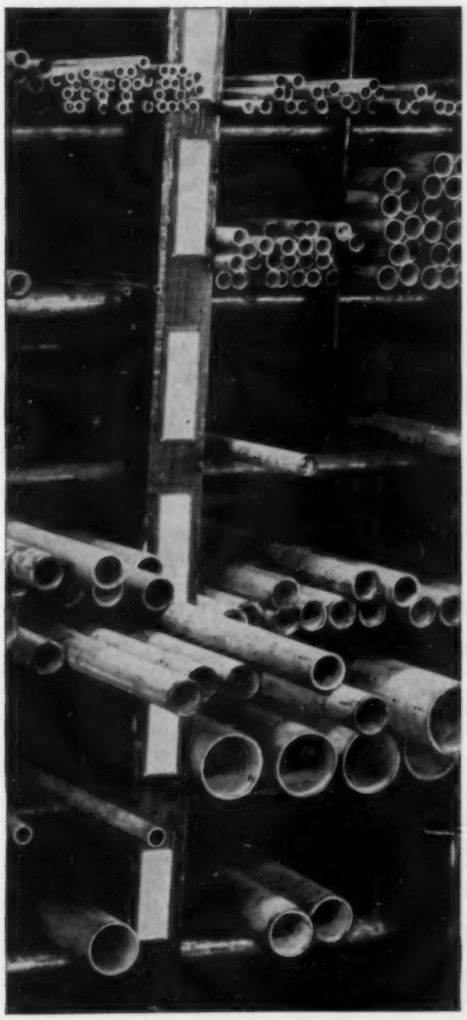
It's plain to see that this is bright, smooth, clean tubing under its protective coating that says "no" to rust and corrosion during shipment and storage.

TESTED!

And not just random sampling! Every length of Superior (SAE) hydraulic tubing is 100% hydrostatically tested at maximum working pressure.

HYDRAULIC STEEL TUBING

dependable, leakproof system



SUPERIOR (SAE) HYDRAULIC STEEL TUBING

is a product of refined tubing techniques, rigid quality control

COLD-DRAWN AND ANNEALED several times after initial reduction, Superior hydraulic tubing always reveals an excellent fine-grain structure under microscopic examination.

CONTROLLED ATMOSPHERE ANNEALING prevents carbon pickup, assures a maximum carbon content of only 0.12%. This results in non-aging, ductile tubing with bright, scalefree OD and ID.

FLARE INSPECTED on a basis of 35% minimum increase on OD, the tubing is highly ductile to permit easy hand bending without pinching, can be readily fabricated for any hydraulic application.

CAREFUL HANDLING of every order includes dipping tubing for rust prevention, wrapping in waterproof paper, and boxing for shipment.

AVOID CRITICAL FAILURES AND COSTLY DOWNTIME—SPECIFY SUPERIOR

Superior Seamless (SAE) Hydraulic Low Carbon Steel Tubing is available in cut, multiple or random lengths up to 30 ft., or longer in coiled form. For prompt, reliable service, call your nearest Superior distributor. For more information on hydraulic tubing, get your free copy of Bulletin 39. Write Superior Tube Company, 2030 Germantown Ave., Norristown, Pa.

Superior Tube

the big name in small tubing

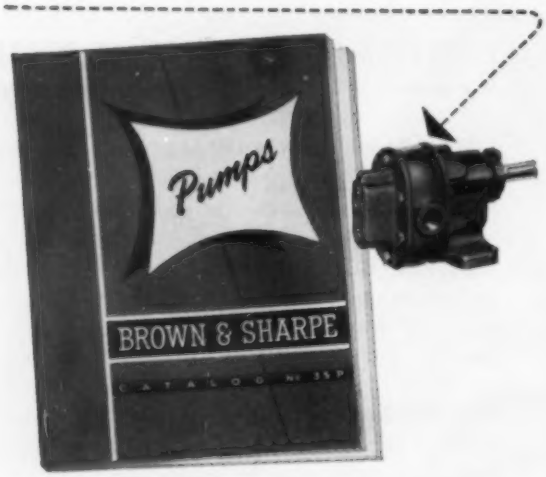
NORRISTOWN, PA.

All analyses .010 in. to ⅝ in. OD—certain analyses in light walls up to 2½ in. OD

West Coast: Pacific Tube Company, 5710 Smithway St., Los Angeles 22, Calif. • RAymond 3-1331

This free book can be a

BIG HELP TO YOU IN SPECIFYING AND ORDERING PUMPS



The Brown & Sharpe Pump Manual includes:

1 CATALOG OF STOCK PUMPS AND SPECIAL PUMPS MADE FROM STOCK PARTS

Brown & Sharpe produces a diversified line of reliable gear, vane and centrifugal pumps . . . with parts that are interchangeable because they are precision made. Frequently, a basic model and stock parts can be used to create the exact pump you need at a surprisingly low cost. Such a pump is far more efficient for your use than a stock pump that doesn't quite suit the application . . . far less expensive than a unit that is completely custom-made.

2 HELPFUL ENGINEERING INFORMATION TO MAKE SPECIFYING PUMPS QUICKER AND EASIER

Pump dimensions and performance charts. Instructions on how to select pumps and motors for various viscosities, pressures, capacities, powers and speeds. Suggestions on planning mountings and selecting accessories. Definitions, conversion tables, and other information to aid in choosing pumps, their uses and applications.

3 PUMP ANALYSIS FORM, RETURNABLE TO BROWN & SHARPE FOR ACCURATE ESTIMATES OR ACTION ON YOUR REQUIREMENTS

This is an easy-to-complete sheet that tells Brown & Sharpe hydraulic engineers what they need to know to help you. Brown & Sharpe Mfg. Co., Providence, R. I.

SEND TODAY FOR FREE PUMP MANUAL

Brown & Sharpe B·S

PUMPS, MILLING, GRINDING AND SCREW MACHINES, CUTTERS, MACHINE TOOL ACCESSORIES, PRECISION TOOLS

LETTERS to the editor

Address your letters to: Editor, APPLIED HYDRAULICS Magazine, 812 Huron Rd., Cleveland 15, Ohio.

Central Station Hydraulics

We were very pleased to see a section on this phase of hydraulics in your July issue. Our manufacture of high pressure reciprocating pumps gives us a very definite interest in central accumulator systems. We sincerely hope that central station hydraulics will be a regular feature of your magazine.

R. KENNETH GROBHOLZ
Manager
Power Pump Sales
Worthington Corporation
Oil City, Pa.

Our editors are continually looking for interesting designs and applications using reciprocating plunger pumps. The two articles in the July issue were developed by field trips. Central station hydraulics is an important area of our coverage.

Master Catalog

One of my manufacturing clients overseas has asked me to secure a copy of your Master Catalog of Fluid Power Products. This client intends to purchase various hydraulic pumps, cylinders, controls etc. Also, can we write to you on various problems concerning hydraulics?

HOWARD J. WEBER
Manufacturers Representative
3561 Jasmine St.,
Denver, Colorado

The 1958-59 edition of the FLUID POWER DIRECTORY *will be available this fall and can be ordered from us. Price per copy is $6.50. We will be glad to offer what information we can concerning hydraulic design.*

Poly-Sulphide Leathers

We noticed an error in your report on Fabricating Machinery Forum in Your July issue. Under the paragraph heading "Are There

Continued on page 22

Eastman

First to be specified by America's leading OEM's

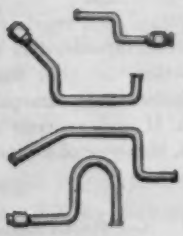
It's a known fact that many leading Original Equipment Manufacturers submit their original specifications for their *first* quotation to Eastman.

EASTMAN's unequalled experience in hydraulic conversion, plus many original designs shown in a few popular Eastman fittings at the right—give your product an appearance of quality that improves its competitive position in your field. It's a mark of distinction to be Eastman equipped!

EASTMAN Engineering Service . . . Backed by Unequalled Experience

It is also a known fact that Eastman's co-operative engineering counsel and service is highly respected and often requested by leading OEM's. Let Eastman engineers help you lay out your fluid power lines—from pump to point of work—effecting economies in design, improving performance and increasing user satisfaction.

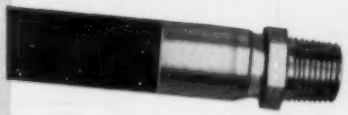
Let EASTMAN recommend the *best assembly . . . for the best performance . . . at the lowest cost.*



Bent Tubing with the necessary fittings to meet your own specific requirements.

Adapters, Adapter Unions and Boss "O" Ring Fittings. All types and sizes available.

A COMPLETE LINE OF HYDRAULIC FITTINGS and HOSE ASSEMBLIES . . .



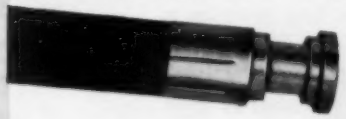
Permanently Attached Male (NPTF) for 1, 2 and 3 wire braid rubber cover hose, and 4 spiral wire extra high pressure hose.
Sizes: 3/16" thru 3".
Wkg. pressure: 375—5000 p.s.i.

Permanently Attached Male Flare (JIC) for 1, 2 and 3 wire braid rubber cover hose.
Sizes: 3/16" thru 2".
Wkg. pressure: 375—5000 p.s.i.

Permanently Attached Swivel Female for 1, 2 and 3 wire braid rubber cover hose.
Sizes: 3/16" thru 2".
Wkg. pressure: 375—5000 p.s.i.

Reusable Male (NPTF) for rubber and cotton cover hose.
Sizes: 3/16" thru 1 3/16".
Wkg. pressure: 375—5000 p.s.i.

Reusable Swivel Female for rubber and cotton cover hose.
Sizes: 3/16" thru 1 3/16".
Wkg. pressure: 375—5000 p.s.i.



Permanently Attached Flanged Head Couplings for 1 and 2 wire braid rubber cover hose.
Sizes: 1/4" thru 2".
Wkg. pressure: 375—5000 p.s.i.

Clamp Type Coupling with split flange stems for 1 and 2 wire braid rubber cover hose.
Sizes: 1/4" thru 2".
Wkg. pressure: 375—5000 p.s.i.

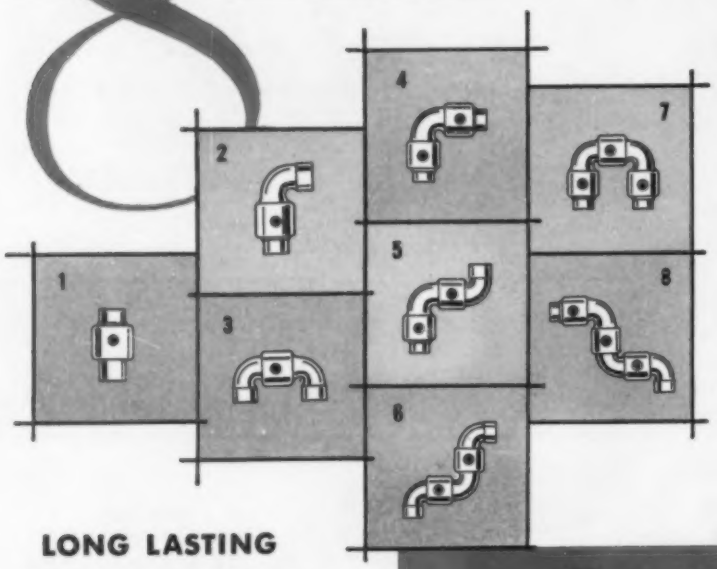
Power Steering Assemblies to meet all your requirements.

Eastman *first in the field*

MANUFACTURING COMPANY
Dept. AH-9
MANITOWOC, WISCONSIN

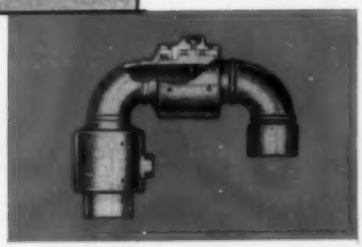
ENGINEERS:
Write for Technical Bulletin 200 for Complete Information and Data on Fluid Power Lines.

EIGHT BASIC STYLES
OVER 500 MODELS



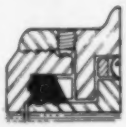
LONG LASTING

CONTINENTAL-EMSCO SWIVEL JOINTS



Continental-Emsco Swivel Joints are manufactured in all popular sizes for practically every type of service; from high vacuum to pressures of 15,000 psi, and from sub-zero temperatures to 750°. You can service a Continental-Emsco Swivel Joint without removing it from the line. Just break the joint as you would a pipe union. Packing is then readily accessible and can be replaced when necessary. No expensive returns to factory for repair.

Call or write today for complete information.



Grooved packing for high temperatures or corrosive services.

Lip type packing for both high and low pressures.

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Serving the Oil and Gas Industries ... Worldwide

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A Division of The Youngstown Sheet and Tube Company

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Export Representative, R. J. Sicho & Associates, Inc.
10 Columbus Circle, New York 19, N.Y.

LETTERS to the editor

Satisfactory Packings for Use With Synthetic Fluids", in the first paragraph on page 122, you reported: "The poly-sulphide impregnated leathers are good for all fluids and are fabricated in V-rings, cups, O-rings and flanges. We are sure you meant U-rings instead of O-rings.

H. BLAIR
Hydraulic Engineer
Detroit Division
E. F. Houghton & Co.
Detroit, Mich.

Thanks for pointing out this error. You are quite right. O-rings should have been U-rings in this report.

Aviation Section Reprints

We find your magazine extremely useful in the rocket engine development work which we are doing here at Reaction Motors. We would appreciate three reprints of each of the following articles:

May 1957, "Selection of Flareless Fittings."

July 1956, "Hydraulic Fluids for 400 F."

Feb. 1957, Designating Flow Restrictors."

Aug. 1956, "Self-Displacing Accumulator."

Mar. 1957, "Evaluating Aircraft Hydraulic Filters."

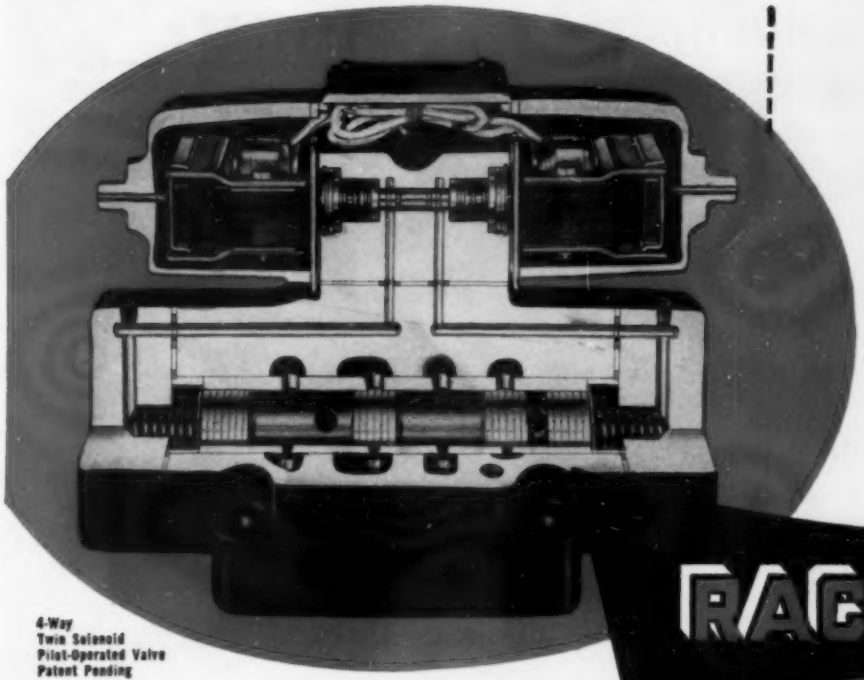
Nov. 1956, "How to Get Accurate Flow Readings."

If possible, please send reprints of all articles which appeared in the Aviation Section of your magazine over the several years prior to July 1956. If such reprints are not available, please send an index of these articles.

J. A. SCHELLER
Asst. Project Engineer
Reaction Motors, Inc.
Denville, N. J.

We have sent at least one set of tearsheets of each article you requested. When available, we attached three sets. We cannot supply you with reprints of all articles which appeared in the Aviation Section prior to July 1956. We enclosed a copy of the January 1956 Fluid Power Index Issue

Continued on page 24



4-Way
Twin Solenoid
Pilot-Operated Valve
Patent Pending

RACINE®

SLEEVE TYPE VALVES GIVE BETTER CONTROL

Proper control of oil flow improves the operation of your machines.

RACINE Sleeve Type Valves are designed with round drilled parts that assure smooth, control of oil to cylinders and fluid motors.

These RACINE Valves are provided with dust-proof solenoid covers — a pending patent includes a RACINE feature that prevents solenoid operation and injury to operator when covers are removed or loose.

Built to J.I.C. specifications RACINE Valves are approved for use in all critical applications. They are precision-built, compact, and rugged in design. Operating pressures to 2000 psi with full back pressure on exhaust port.

Your machine will operate better, with less maintenance because of longer life of RACINE Sleeve construction. Write today for complete catalog showing why "Sleeve Type Valves give Better Control."

OTHER RACINE HYDRAULIC PRODUCTS

MODEL Q
Variable Volume
Vane Type
Hydraulic Pump

PRESSURE BOOSTER
Up to 5000 psi
Up to 7:1 pressure ratio

FLUID MOTOR
Vane Type
50 to 3500 rpm
Pressures to 1500 psi

RESERVOIR
With Control Panel
Designed to your space
and circuit requirements

RACINE

NFPA NATIONAL FLUID POWER ASSOCIATION

RACINE HYDRAULICS & MACHINERY, INC.
2074 Albert Street
RACINE, WISCONSIN, U. S. A.

Mr. Plant Engineer–

You're responsible for EFFICIENT air supply to pneumatic equipment

Here are
BRAND NEW
high-efficiency units . . . better air service . . . easier to maintain

Delivers really CLEAN dry air

Watts Filter delivers clean dry air to Federal Products Dimensionair.

High-Efficiency FILTER with exclusive "Tornado Action."

Extreme centrifugal force spirals dirt and moisture particles downward into the "quiet zone" leaving in the air only a minute percentage of the finest and lightest particles which are trapped by the filter cone.

Maintains MORE UNIFORM PRESSURE

Watts Regulator maintains uniform air pressure for Scott-Williams KN Knitting Machine

High-Efficiency REGULATOR with highly sensitive "Aspirator Action."

Watts Aspirator control acts directly on the diaphragm, giving instant compensation for fluctuating pressure demands . . . provides precise control and stabilizes pressures reaching individual pieces of equipment.

LUBRICATES perfectly at all flow rates

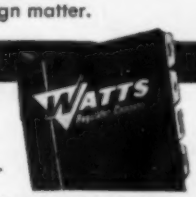
Watts Lubricator provides efficient lubrication for Markem Machine Company's Model 70AF.

High-Efficiency LUBRICATOR with exclusive "By-pass pick-up."

Watts new By-Pass Pick-Up makes possible a sub-miniature, high velocity venturi section which positively creates sufficient force – even at flow rates as low as one cubic foot per minute – to vaporize oil into a fine mist for uniform, economical lubrication.

BEFORE YOU MAKE ANY COMMITMENTS –
get the facts on Watts new-design units which open up new worlds of efficiency in Pneumatic Operation, Line Maintenance, and Protection of Equipment against foreign matter.

REQUEST CATALOG AND DETAILED SPECIFICATION SHEETS



WATTS REGULATOR COMPANY
SINCE 1875

8 EMBANKMENT ROAD LAWRENCE, MASSACHUSETTS

LETTERS to the editor

which you should find valuable as a reference to articles published in APPLIED HYDRAULICS *and all other publications on the subject of fluid power.*

JIC Symbols

We are interested in using the JIC standardized symbols for hydraulic units, and would like to know if the series of symbols is finalized. Also, to what extent have these symbols been accepted by the aircraft industry and the Armed Forces agencies? Please advise how we can secure the entire series of symbols.

RICHARD M. ASHBY
Chief Checker
Pacific Division
Bendix Aviation Corp.
North Hollywood, Calif.

These symbols have been widely accepted and are used almost exclusively in industry. The American Standards Association is setting up a tentative standard which will undoubtedly be accepted. In our 1958-59 FLUID POWER DIRECTORY, *which will be published October 28th, the complete standards will be included. You can obtain copies of the complete JIC Standards from: Joint Industry Conference, Box* 182 *Northend Station, Detroit* 2, *Mich. The most complete presentation of symbols and how to use them has been shown in* APPLIED HYDRAULICS, *and will be again shown in the* FLUID POWER DIRECTORY. *We have not seen much acceptance of these standards by the aircraft industry for aircraft circuits—possibly because the aircraft people developed symbols of their own. Nevertheless, we feel that the symbols they are now using are not as clear as JIC symbols, which permit tracing a circuit with ease. Perhaps this is a subject which your aircraft design people can discuss. We would be pleased to give you any information we can. Our regular monthly Aviation Section covers material on hydraulic and pneumatic circuits, and in most cases JIC symbols are used.*

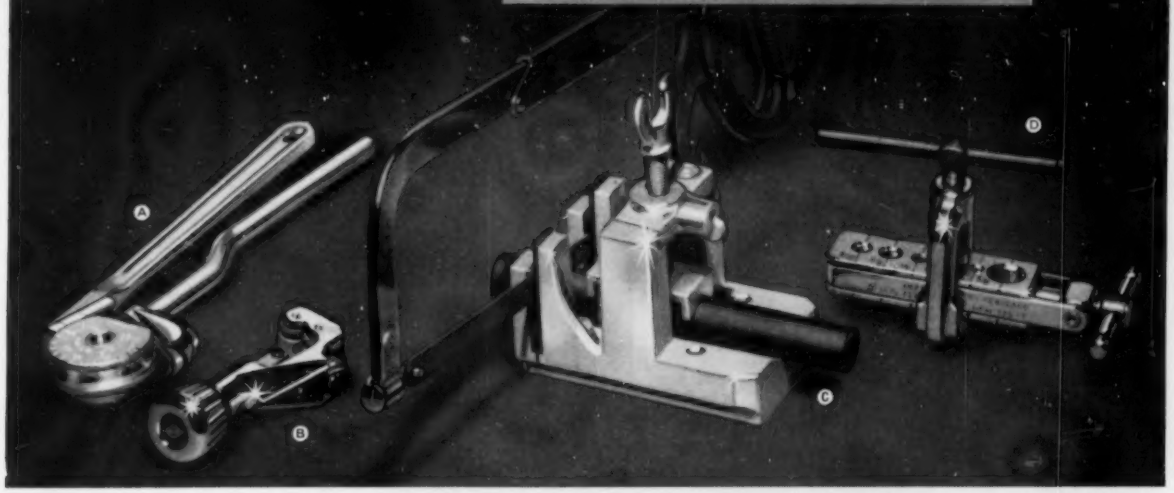
Continued on page 26

NEW TOOL DEVELOPMENTS BY IMPERIAL

BY-PASS OLD METHODS OF CUTTING, BENDING, AND FLARING TUBING

ALSO CUTTING WIRE BRAID HOSE.

URGE IMMEDIATE INVESTIGATION



Ⓐ **Bends hard or soft tubing.** Open side design. Forms neat, accurate bends, any angle up to 180°. Calibrated. Specify No. 364-FH "Blue Dot" bender. Sizes: ⅛ to ¼" O.D. tubing. Individual benders for each size.

Ⓑ **Spare cutting wheel now included at no extra cost!** Exclusive! Fits behind retractable reamer. Instantly available for emergencies. Cutter has free-wheeling, ball bearing action. No. 274-F Hi-Duty tube cutter for ⅛ to 1" O.D. tubing.

Ⓒ **Saws wire-braid pressure hose with minimum wear to hacksaw blade.** Square, clean cuts due to special hose gripper. Extra-tight, slide-to-size clamping. For 3/16 to 1½" O.D. hose or tubing. Bolts to bench or clamps in a vise. No. 384-F illustrated.

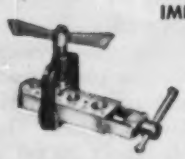
Ⓓ **Now with industrial hard chrome cones.** No extra cost! Smoother flares, up to 55% easier! Types for 45°, 37° and double flares. No. 437-F for 37° flares on soft steel tubing to J.I.C. standards. Sizes: 3/16, ¼, 5/16, 3/8, ½ and 5/8" O.D. tubing.

Imperial offers you industry's most complete line of tube working tools with more work-saving features!

If it's new . . . it's from Imperial! The complete tubing tool line with more "firsts" to its credit continues to take the "work" out of tube working with *more* new developments!

That means no matter what the tubing . . . copper, aluminum, steel or stainless steel . . . or the type of job, you're adding greater accuracy, speed, ease and better craftsmanship to cut costs right down the line. *Tool up with Imperial and be first with the latest!*

Avoid lost time and grief by replacing labor-wasting tools NOW with years-ahead IMPERIAL tubing tools. See your Imperial distributor now, or write for Catalog 3011.



No. 500-F and No. 507-F Rol-Air flaring tools for 45° and 37° flares.

No. 140-F Test plug — for closing end of tube temporarily. Pressures to 100 lbs.

No. 206-F — Adjust-o-matic, slide-to-size tube cutter. For ¾" to 2¼" O.D. Tubing.

No. 400-F flares stainless steel, titanium — other metal tubing to AN standards.

No. 270-F Gear type bender bends any type of tubing.

No. 260-F tube bender combination for 7 sizes: ⅛ to ⅝" O.D.

IMPERIAL

THE IMPERIAL BRASS MFG. CO.
1242 W. Harrison St., Chicago 7, Ill.
In Canada: 334 Lauder Ave., Toronto, Ontario

Emblem of Quality

positive, automatic PRESSURE CONTROL
you can depend on

FULFLO piston type, oil-relief hydraulic by-pass valves are designed and built so you can install 'em, then forget 'em! They are quiet, non-chattering because of shear-closing action. Low price and high quality, make Fulflo Valves a wise choice for O.E.M. use . . . replacement too! Available with "O" Ring or Gasket Seal.

- **Standard and Flanged models**
- **Just 6 springs for pressures to 500#**
- **Cast iron or brass bodies**
- **Brass, steel or stainless pistons**
- **Pipe sizes to 2½"**
- **SPECIALS to your requirements**

FULFLO

WRITE FOR "Fulflo Valves Mechanical Data Book", free helpful reference.

THE FULFLO SPECIALTIES CO., INC.
415 Fancy Ave., Blanchester, Ohio

LETTERS to the editor

3000-psi Oil Circuits

We would like information on basic design of hydraulic circuits for 3000 psi, to be used on aircraft or similar high-pressure applications.

A. M. DESANCTIS
Rochester Engineering Dept.
American Machine & Foundry Co.
Rochester, N.Y.

A recent book "Aircraft Hydraulic Design" authored by George Keller, will give you information on this subject. Copies may be ordered from us. Price per copy is $4.50. *Also,* APPLIED HYDRAULICS *publishes an Aviation Section each month, and much of the material regularly published will prove of assistance.*

Air Circuit

In the article "Air Controls Oil Circuits on a 2000-ton Press", everything is correct except the diagram of the holding valve, showing the check in the reverse direction from that shown on our drawing. I have received one inquiry from New York pointing out this reversed valve, and another from Milwaukee questioning why we use two relief valves in parallel instead of one larger one. The answer to the latter is economics. Many thanks for a job well done.

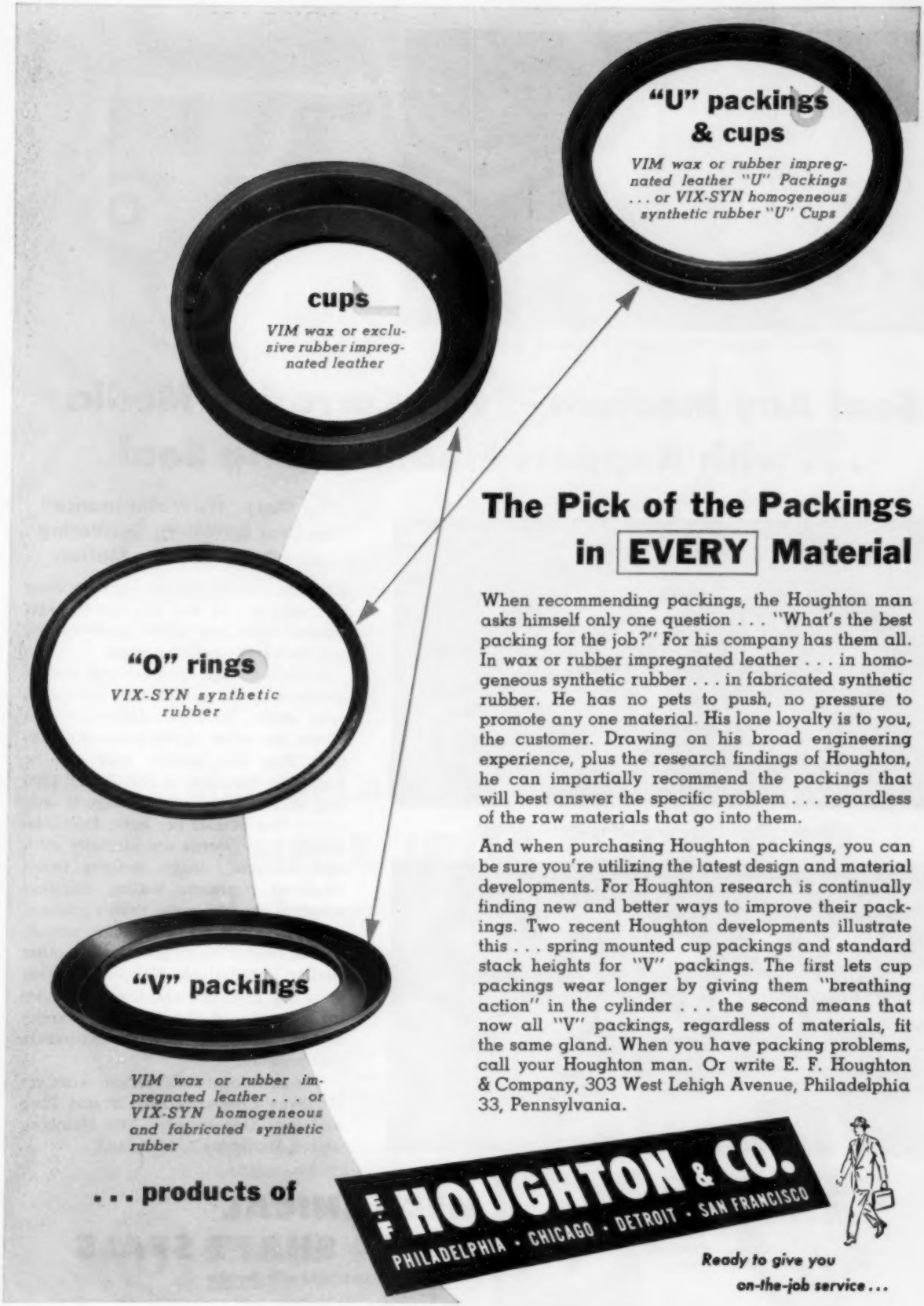
S. H. DURBIN
Associate Chief Engineer
E. W. Bliss Company
Canton, Ohio

Two Pressure System

We are looking for a source of pumps, one on each end of the motor, for using two pressure system on hydraulic presses; one for closing and return, and the other for slow approach. One range would be about 30 psi at 100 gpm and the other, 2000 psi at 5 gpm.

E. C. LaRUE
Purchasing Agent
A. J. Wahl, Inc.
Brocton, N.Y.

We have sent you a list of manufacturers who can supply your requirements for both pumps. ▼▼▼


"U" packings & cups
VIM wax or rubber impregnated leather "U" Packings . . . or VIX-SYN homogeneous synthetic rubber "U" Cups
cups
VIM wax or exclusive rubber impregnated leather
"O" rings
VIX-SYN synthetic rubber
"V" packings
VIM wax or rubber impregnated leather . . . or VIX-SYN homogeneous and fabricated synthetic rubber

The Pick of the Packings in EVERY Material

When recommending packings, the Houghton man asks himself only one question . . . "What's the best packing for the job?" For his company has them all. In wax or rubber impregnated leather . . . in homogeneous synthetic rubber . . . in fabricated synthetic rubber. He has no pets to push, no pressure to promote any one material. His lone loyalty is to you, the customer. Drawing on his broad engineering experience, plus the research findings of Houghton, he can impartially recommend the packings that will best answer the specific problem . . . regardless of the raw materials that go into them.

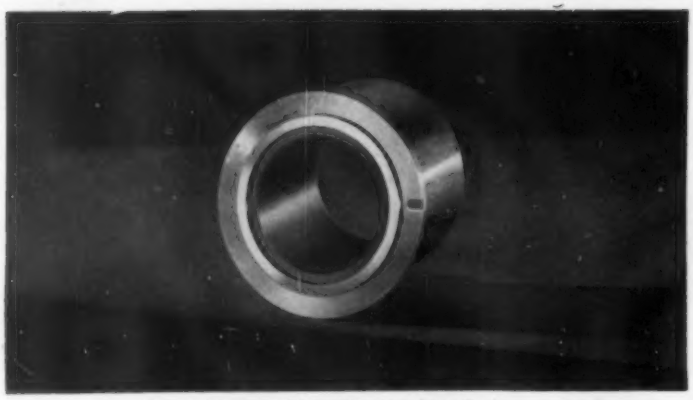
And when purchasing Houghton packings, you can be sure you're utilizing the latest design and material developments. For Houghton research is continually finding new and better ways to improve their packings. Two recent Houghton developments illustrate this . . . spring mounted cup packings and standard stack heights for "V" packings. The first lets cup packings wear longer by giving them "breathing action" in the cylinder . . . the second means that now all "V" packings, regardless of materials, fit the same gland. When you have packing problems, call your Houghton man. Or write E. F. Houghton & Company, 303 West Lehigh Avenue, Philadelphia 33, Pennsylvania.

. . . products of

E. F. HOUGHTON & CO.

PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

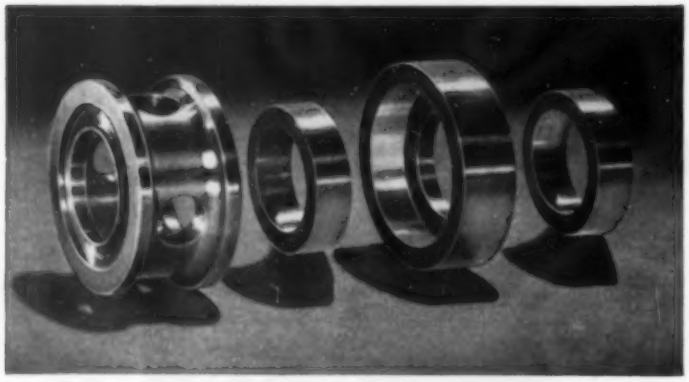
Ready to give you on-the-job service . . .



SINGLE BUSHING TYPE Floating Ring Seal

Seal Any Medium—Even Corrosive Media ...with Koppers Floating Ring Seal

MULTIPLE RING TYPE Floating Ring Seal (assembled)



FLOATING RING SEAL Basic Elements: Lantern Ring, Floating Ring, and Spacer Diaphragm. As sealing needs dictate, floating rings and spacer diaphragms are added. Seals are carbon, plastics, ceramics or steel, as applications require.

The Only "No Maintenance" Seal for Rotating, Oscillating and Reciprocating Motion

Koppers' precise, efficient Floating Ring Seal assures long seal life, low leakage, reduced wear, less power consumption, and decreased operating costs.

It seals at high temperatures and at pressures up to, and for some conditions even above, 2000 psi. Inspection has shown that after 10,000 hours of operation, ring and spindle wear can be negligible. For water at 500° F. and 1200 psig with a $\frac{5}{8}$" spindle, leakage is only one to two pounds per hour. Frictional power requirements are virtually zero, and Koppers' design reduces radial frictional restraint. Sealing members adapt to changes in the shaft's position.

Applicable to valve spindles, pumps, atomic reactor spindles and many other similar installations, Koppers Floating Ring Seal gives efficient, low-cost service for the sealing of all types of fluids under widely varying conditions of temperature and pressure.

For additional information, write to: KOPPERS COMPANY, INC., Piston Ring and Seal Department, 1509 Hamburg Street, Baltimore 3, Maryland.

KOPPERS

MECHANICAL SHAFT SEALS

Engineered Products sold with *Service*

Factory Mutual Laboratories, Norwood, Mass.

Factory Mutual Laboratories test

SHELL IRUS FLUID 902

the low-cost, fire-resistant hydraulic fluid

Factory Mutual Laboratories, the well-known industrial testing authority, recently evaluated Shell Irus* Fluid 902.

The tests performed included:

1. **Flash Point**
2. **Autoignition**
3. **Flame Propagation**

The Shell Industrial Engineer can give you more information about these tests.

*Trademark

In plant after plant, users find that Shell Irus Fluid 902 is comparable in fire resistance to much higher-priced hydraulic fluids.

SHELL OIL COMPANY

50 WEST 50TH STREET, NEW YORK 20, NEW YORK
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SHELL

Circle 135 on Reader Service Card

BRIEFS about fluid power

1957 HYDRAULICS CONFERENCE

. . . 13th Annual Meeting . . . Sherman Hotel, Chicago . . . October 17-18

• **What it is**—The National Conference on Industrial Hydraulics is non-profit, non-commercial, and devoted to increasing and spreading technical knowledge of hydraulics. It is sponsored by Illinois Institute of Technology, with the cooperation of the hydraulics industry and engineering societies.

• **History**—NCIH held its first meeting in 1945. At that time, Armour Research Foundation of Illinois Tech, and the Graduate School, recognized the need for closer cooperation between different engineering fields in solving industrial problems, and sponsored the first technical meeting. Success of the first conference led to its establishment as an annual event.

• **What it does**—Each year at the Annual Meeting, experts in various phases of the industry present papers, hold panel discussions, and answer questions. Those attending receive the most recent information on developments, applications, and suggestions for solving particular problems. The Proceedings of the Conference are later published and made available for further reference. NCIH also sponsors an educational program in Industrial Hydraulics at Illinois Tech. With the cooperation of the industry, a well-equipped laboratory is available for study and student research. The conference is open to all persons interested in the field of hydraulics. Engineers and management people are invited to attend the annual meeting and participate in the educational program.

• **Importance to industry**—For many years hydraulic problems were solved by individual groups from the standpoint of their own particular needs. Use of hydraulics now covers almost every area of industry, and problems are mutual in many fields. The NCIH provides a common meeting place for engineers in all branches of the profession interested in industrial hydraulics. Since these annual meetings attract the top men in various fields of industry, a wealth of information and experience is available.

• **Who attends?**—Past records indicate that these NCIH sessions are attended by key personnel from many different industries. Total attendance at last year's Conference exceeded 1000. These engineers represented users and designers of hydraulic and pneumatic equipment and components. They came from every part of the country, with some from Canada and England.

• **1957 Conference Officers:**

Director: Frank D. Carvin, Director, Department of Mechanical Engineering, Illinois Institute of Technology.

1956 Director: R. O. Isenbarger, Chief Engineer, Chicago Rawhide Mfg. Co.

Associate Director: Ralph J. King, Staff Engineer, Caterpillar Tractor Co.

Secretary: Ray D. Meade, Director of Extension, Illinois Institute of Technology.

• **Program**—This year's program has not yet been completed, but will include sessions on aircraft systems, pneumatics, automatic tools, mobile equipment, servomechanisms and systems, automotive, hydraulic fluids, components and accessories, and pumps.

A regular feature of these Annual Meetings is the presentation of the APPLIED HYDRAULICS Awards to winners of the yearly Prize Paper Contest. Awards for the 5th Annual Prize Paper Contest will be made after the morning session on Thursday, October 17th.

Continued on page 32

TEST PROVES C/R MOLDED CUP

Conventional leather cup. Note rounded shape and thinness of material at heel.

C/R *molded* leather cup. Note sharp angle and full thickness of material at heel.

New molded C/R cups* stand up longer... cut down replacement costs

Compare the wear on these piston cups shown in the unretouched photographs above. They were tested in a hydraulic cylinder at 6000 p.s.i. for 3000 cycles. The one at the right is a Sirvis-Conpor molded leather cup. The other is a conventional leather cup. Features of the C/R molded cup that make it so obviously superior are greater density, the sharp, rather than rounded heel, and the fact that it is pre-formed to the shape which conventional cups are forced to assume under pressure. This eliminates operational stress and flexing that conventional cups undergo, and contributes greatly to longer service life.

Right now, molded C/R cups are providing greatly increased service life in hydraulic cylinders in such heavy duty applications as farm and road building equipment and steel mill equipment at oil pressures up to 3500 p.s.i., and 150 p.s.i. in air cylinders. If you face a difficult packing problem that requires high durability and efficiency . . . it will pay you to consider this new, improved C/R design.

*Available in J.I.C. standard and other popular sizes. Write for complete size list.

CHICAGO RAWHIDE MANUFACTURING COMPANY
1203 Elston Avenue Chicago 22, Illinois

Offices in 55 Principal Cities. See your telephone book.

In Canada: Distributed by Chicago Rawhide Mfg. Co. of Canada, Ltd., Hamilton, Ontario

Export Sales: Geon International Corp., Great Neck, New York

SIRVIS C/R DIVISION
CHICAGO RAWHIDE

Other C/R Products

C/R Shaft & End Face Seals • Sirvene (synthetic rubber) molded pliable parts • C/R Non-metallic Gears

Young SAMPLE FLUID COOLER

chosen for use on new

ATOMIC SUB "SKATE"

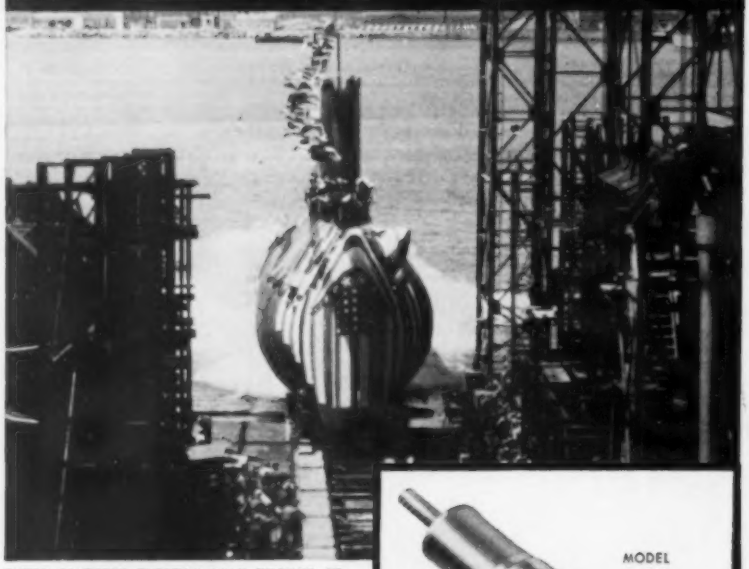
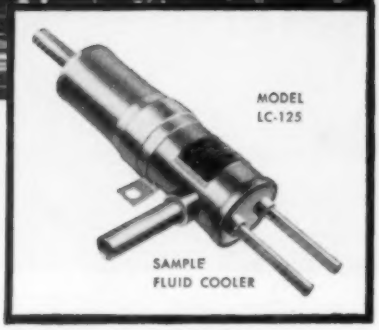


PHOTO COURTESY ELECTRIC BOAT DIVISION OF GENERAL DYNAMICS CORPORATION

Unit shown
cools reactor water
from 500° F.
to 150° F.



Young shell and tubular coil sample fluid coolers will reduce temperatures from 600° F. to 100° F. at pressures up to 1,500 psi. These small, compact units cool sample fluids for control testing purposes for pilot plants, boiler water samples, chemical and other high temperature and pressure process fluids.

"WHERE QUALITY COUNTS"

Write today to Dept. 447-J for catalog 2125-A. There is no obligation.

Young RADIATOR COMPANY

RACINE, WISCONSIN

Creative HEAT TRANSFER ENGINEERS

Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Mattoon, Illinois

BRIEFS / continued

Over twenty technical papers will be presented at this year's Conference. Some of the topics covered will include:

Ever Higher Temperatures . . . for aircraft hydraulic systems. F. H. Pollard, Chief Hydraulic Engineer, Republic Aviation Corp., discusses design problems of fluids, packings, and power requirements.

High Pressure Pneumatics . . . increase over-all aircraft reliability. T. H. Chadwick, Senior Design Group Engineer, and Paul L. Brady, Design Group Engineer, Convair Div. General Dynamics Corp., point out the advantages of air in aircraft service.

Air At 3000-5000 Psi . . . is required for missile control. Leonard L. Baker, Managing Engineer, Mechanical Laboratory, Chrysler Missile Operations, Chrysler Corp., covers the advantages of high-pressure pneumatics and the dangers of a compressible fluid system.

Smooth Ride Over Rough Terrain . . . is provided by LeTourneau-Westinghouse "hydrair" suspension. Ralph H. Kress, Manager, Truck Div., LeTourneau-Westinghouse Co., explains the workings of their new air-oil unit developed for off-the-highway equipment.

Fluids Under High Pressure . . . require special methods to measure their viscosities and compressibilities. Rex T. Ellington, Asst. Research Director, and Bertram E. Eakin, Supv. Reservoir Engineering Research, Institute of Gas Technology, present a survey of techniques.

Preventing Fluid Leakage . . . is an increasingly important factor with ever-higher

Continued on page 37

Circle 169 on Reader Service Card

Miller®

4 New Hydraulic Cylinder Features Benefit You 9 Ways ...At No Added Cost

MORE MILLER "FIRSTS"

NEW! ALL TEFLON* SEALED AGAINST EXTERNAL LEAKAGE...

1. Eliminates Seal Damage from Fluids—Teflon is Impervious to all Hydraulic Fluids (Including Fire-Resistant Types) . . . Hydraulic Cylinders with Teflon Piston Cups Slightly Higher.
2. Eliminates Seal Damage from High Temperatures —Teflon Sealed Cylinders Operate At —100° F. to 500° F.

NEW! ROD BUSHING SEAL . . .

1. Eliminates Shearing of "O" Ring in Re-Assembly
2. Eliminates Extrusion of "O" Ring at Extreme Pressures.

NEW! SHEF SEAL AT TUBING ENDS . . .

1. Eliminates Shearing of "O" Ring in Re-Assembly
2. Eliminates Extrusion of "O" Ring at ANY Pressure—Teflon Sealing Ring is Backed Up by Zero Clearance Metal Shoulder.

NEW! LOCK-SEAL CUSHION ADJUSTMENT SCREW . . .

1. Eliminates Screw Projection Beyond Head and Cap — Cylinders Mount on Any Side.
2. Eliminates Manual Sealing and Locking After Flow Adjustment—Teflon Seal is Self Regulating and Self Locking.
3. Eliminates Accessibility Problems—Cushion Screw Interchangeable with Ball Check Position—Adjustable Through Small Wrench Hole Drilled in Interfering Machinery.

*du Pont trademark for its tetrafluoroethylene resin

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Turn Page For Cross Section Of SHEF SEAL

S SHEAR PROOF
H HEAT PROOF
E EXTRUSION PROOF
F FLUID PROOF
SEAL
Teflon Pressure Energized
Hydraulic Cylinder Tubing End Seal

OTHER MILLER QUALITY FEATURES

- Case-Hardened Chrome Plated Piston Rod
- Rust Resistant Surfaces
- Teflon Oil and Dirt Wipers
- Interchangeable Square Design

Miller FLUID POWER DIVISION
FLICK-REEDY CORPORATION
2008 N. Hawthorne Ave., Melrose Park, Ill.

AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS

Miller

Announces a New Space and Price Saving Hydraulic Cylinder Line

MORE MILLER "FIRSTS"

SAVE UP TO 76% OF COST

Heavy Duty Model LH—Same Size As Ordinary Gasket Type Square Design Low Pressure Cylinders			
BORE	NORMAL RATINGS	NON-SHOCK INTERMITTENT RATINGS	YOU SAVE THIS % IN PRICE OVER STANDARD 2000-3000 PSI CYLINDERS
1½"	1500 PSI	2500 PSI	27%
2	1500	2500	27%
2½	1000	1500	28%
3¼	1500	2500	32%
4	1000	1500	35%
5	800	1200	37%
6	800	1200	43%
8	500	800	50%
10	500	800	71%
12	500	800	76%
14	500	800	*Not Available in 2000-3000 PSI*

Miller

Announces 50% More Power Per Cylinder Dollar

with Extra Heavy Duty

3000-5000 PSI MODEL H

HYDRAULIC CYLINDERS

Same Price and Mounting Dimensions as Miller 2000-3000 PSI Hydraulic Cylinders.

BOTH LINES MADE POSSIBLE BY SHEF SEAL

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Miller - FLUID POWER DIVISION
FLICK-REEDY CORPORATION

AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS

OTHER MILLER QUALITY FEATURES

- All Teflon Sealed Against External Leakage—Teflon Cups Extra
- Case-Hardened Chrome Plated Piston Rod
- Shear Proof Rod Bushing Seal
- Ball Check Interchangeable with Self Sealing and Locking Cushion Adjustment
- Rust Resistant Surfaces
- Teflon Oil and Dirt Wipers

S SHEAR PROOF
H HEAT PROOF
E EXTRUSION PROOF
F FLUID PROOF
SEAL
Teflon Pressure Energized
Hydraulic Cylinder Tubing End Seal
PAT. APPLIED FOR

SHEF SEAL Obsoletes All Other Hydraulic Cylinder End Seals . . . *at no added cost*

HAS EVERY ADVANTAGE

1. Pressure Energized—Sealing Effectiveness Increased with Pressure.
2. Zero Metal-To-Metal Clearance at all Pressures Gives You Perfect Seal Backup. Sealing Ring Cannot Extrude.
3. Simplified Servicing. No "Blind" Assembly. Sealing Ring Cannot Shear.
4. Teflon* Sealing Ring Withstands All Hydraulic Fluids at Temperatures from —100° F. to 500° F.
5. Head and Cap Axial Movement Does Not Destroy Sealing.
6. Allows Air Bleed In Head and Cap for Remote or Automatic Bleeding.
7. One Sealing Ring Cross Section Dimension For All Cylinder Sizes—Supplied On Convenient Spools.
8. Zero Metal Backup Clearance Eliminates Dangerous Leaks and Spurts of Fluid Due To Seal Failure.

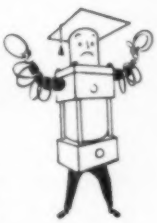
NONE OF THESE DISADVANTAGES

GASKET CONSTRUCTION

1. Unpredictable Results—Leaks and Blows Even at Low Pressures.
2. Outlawed by J.I.C. Eight Years Ago.
3. Seal Failure Causes Dangerous Leaks and Spurts of Fluid. Creates Unnecessary Fire and Safety Hazard.

"O" RING CONSTRUCTION

1. High Pressures and Shock Loads Expand Tubing—Increase Clearance and Cause Extrusion.
2. Blind Assembly Can Shear Sealing Ring—Difficult Servicing.
3. Seal Failure Causes Dangerous Leaks and Spurts of Fluid. Creates Unnecessary Fire and Safety Hazard.
4. Requires Large Inventory of "O" Rings
   —For Servicing Variety of Cylinder Bores.
   —For Special Synthetic Rubber Compounds To Meet Ever Changing Fluid and Temperature Needs.



*du Pont trademark for its tetrafluoroethylene resin.

SHEF SEAL—*Another Miller "First"*

When you buy Miller ... You buy extra years of worry-free Cylinder performance ...at competitive prices

S SHEAR PROOF
H HEAT PROOF
E EXTRUSION PROOF
F FLUID PROOF
SEAL
Teflon Pressure Energized
Hydraulic Cylinder Tubing End Seal
PAT. APPLIED FOR

OTHER MILLER QUALITY FEATURES

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- Case-Hardened Chrome Plated Piston Rod
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- Ball Check Interchangeable with Self Sealing and Locking Cushion Adjustment
- Rust Resistant Surfaces
- Teflon Oil and Dirt Wipers

Miller FLUID POWER DIVISION
FLICK-REEDY CORPORATION

Turn Page For More About MILLER

AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS

COUNTERBALANCE CYLINDERS • BOOSTERS

• Teflon Oil and Dirt Wipers

Hydraulic Cylinder Tubing End Seal
PAT. APPLIED FOR

All Teflon Sealed —Perfect Sealing for Hydraulic Cylinders

HAS EVERY ADVANTAGE...

Teflon—As Static and Dynamic Seals

1. Impervious to Every Hydraulic Fluid Including Fire-Resistant Types.
2. Seals Perfectly in Cylinders at Temperatures from —100° F. to 500° F.
3. Can Be Molded Into Shapes That Have Zero Leakage—Hold Pressure Indefinitely.
4. With Proper Design of External Seal Cavities, Teflon Can Be Included *Without* Increasing Prices. Miller Provides Teflon for all External Seals at Prices Competitive with Ordinary Cylinders. Leather Internal Piston Cups are Standard (Teflon Cups Extra).

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Printed in U.S.A.

•du Pont trademark for its tetrafluoroethylene resin.

When you buy Miller
You buy extra years
of worry-free
Cylinder performance
...at competitive prices

NONE OF THESE DISADVANTAGES

Synthetic Rubber— As Static and Dynamic Seals

1. Unsatisfactory Except When Used With A Limited Range of Hydraulic Fluids.
2. Even Uncontrollable Changes in Fluid Additives Often Destroy Seal.
3. Specific Compounds Needed for Compatibility with Specific Fluids Normally Used Today.
4. Normal Temperature Range Limited to 0° F. to 130° F. Slightly Reduced Life When Operated at 130° F. to 150° F. Greatly Reduced Life at 150° F. to 250° F.
5. External Leakage Causes Fire and Safety Hazards When Temperature or Fluid Destroys Seals.
6. "U" Type Seals Without Mechanical Retainer at Mid-Section Frequently "Roll" and Lose All Sealing Ability.

Resin Impregnated Leather— As Dynamic Seals Only

1. Is Compatible with Many—But Not All—Hydraulic Fluids and Additives Including a few Fire-Resistant Types.
2. Normal Temperature Range Limited to —60° F. to 130° F. Slightly Reduced Life When Operated at 130° F. to 150° F. Substantially Reduced Life at 150° F. to 250° F.
3. External Leakage Causes Fire and Safety Hazards When Temperature or Fluid Destroys Seals.
   Miller Uses Leather Piston Cup Seals for Internal Sealing... Standard Price (Teflon Cups Extra).

Piston Rings— As Dynamic Internal Seals

1. Most Piston Rings Allow Some Leakage.
2. Allow "Slip" or "Drift" of Piston Due To Leakage—Unsatisfactory for Many Applications.
3. Allow Varying Feed Rates Due To Leakage Because Of Viscosity Change During Startup—Unsatisfactory for Most Multiple and Automated Operations.
4. Allow Some Pressure Loss.
5. Chips and Dirt Enter Space Between Piston and Tube Causing Scoring —Especially During Startup.

All Teflon Sealed—*Another Miller "First"*

Miller • FLUID POWER DIVISION
FLICK-REEDY CORPORATION

2008 N. Hawthorne Ave., Melrose Park, Ill.

AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS

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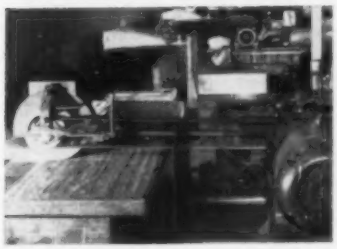
- Rust Resistant Surfaces
- Teflon Oil and Dirt Wipers

BRIEFS continued

pressures and temperatures. G. T. Lyon, President, L & L Mfg. Co., reviews the recent developments in this field.

Fast, Flexible, Rugged Control Systems . . . have been developed for military applications. Bernard A. Johnson, Project Engineer, Cook Research Laboratories, discusses the component which made this possible—the electrohydraulic servo valve.

Centrifugal Pumps . . . for a central source of fluids at high pressures and rapidly varying flow rates. Thomas E. Hall, Administrative Engineer, Byron Jackson Div. of Borg-Warner Corp., outlines the merits of this type pump and applications. ▼▼▼



New hydraulic-electric billet grinders at the Brackenridge plant of Allegheny Ludlum Steel Corp. move on rails up and down the length of the steel slab as the grinding wheels remove surface imperfections. Hydraulic pressure holds the grinding wheel firmly against the slab, as the operator sits and manipulates the power controls. The wheel is moveable in any direction across the slab.

Hydraulic Training Organized

To facilitate the exchange of information and techniques of teaching industrial hydraulics, and to keep members posted on current developments, the Industrial Hydraulics Training Association was formed in July. The Association is open to all persons

Continued on page 40

UCON
BRAND
HYDROLUBES

HELP

PROTECTION The fire-resistance of CARBIDE's fire-resistant hydraulic fluids has been proved by severe, exhaustive laboratory tests. And, in actual service, water-base UCON hydrolubes have prevented serious fires and injuries during more than 10 years of routine use in all types of industrial hydraulic equipment. The common fire hazards connected with hydraulic operations are eliminated when UCON hydrolubes are used. UCON hydrolubes are classified as acceptable, less hazardous fluids by Factory Mutual Laboratories.

ECONOMY UCON hydrolubes 150-CP and 275-CP are the economical answer to fire-resistance in hydraulic fluids. Most commercial hydraulic equipment can be easily converted to UCON hydrolubes with a minimum of time and expense. UCON hydrolubes have no harmful effects on most packings or seals. In fact, in many instances, reduced leakage losses have been reported. UCON hydrolubes also provide maximum protection against liquid and vapor phase corrosion and have outstanding anti-wear characteristics—thus, pump replacement costs are also held to a minimum.

Why not get all the facts on how UCON hydrolubes can mean protection plus economy for you. Write today for the booklet, "UCON Hydrolubes Spell Safety," F-40134.

UNION CARBIDE CHEMICALS COMPANY

Division of UNION CARBIDE Corporation

30 East 42nd Street, New York 17, N. Y.

"Ucon" is a registered trade-mark of UCC.

COUNTERBALANCE CYLINDERS • BOOSTERS

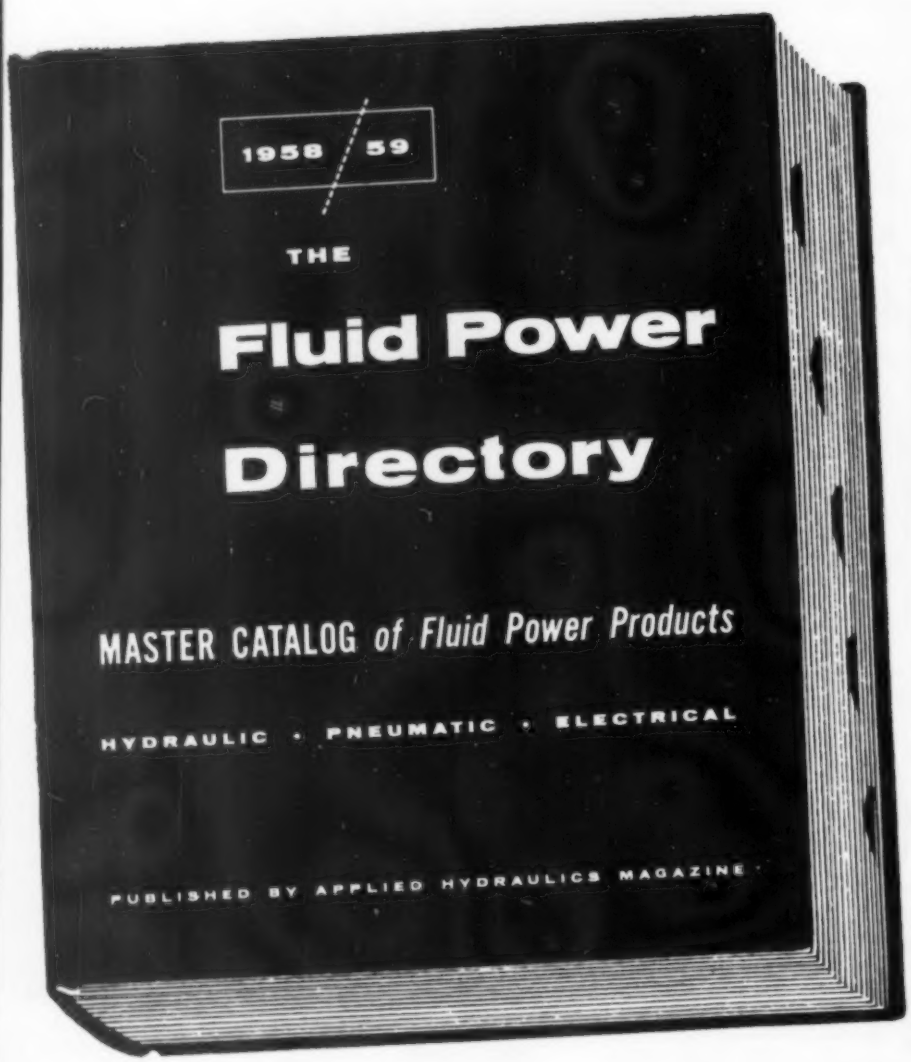
• Rust Resistant Surfaces
• Teflon Oil and Dirt Wipers

Hydraulic Cylinder Tubing End Seal

NOW IN PREPARATION!

The Complete Guide to . . .

2nd EDITION . . . FLUID POWER DIRECTORY . . . . .



SECTION A

FLUID POWER COMPONENTS DIRECTORY—Over 140 pneumatic, hydraulic and electrical products for fluid power systems—from accumulators to wiper rings—are listed in this directory. Listings of advertisers appear in bold face along with the note "See Catalog Section C, pages——— to ———".

SECTION B

TRADE NAMES—Alphabetical listing of product trade names gives manufacturers' names and addresses. Bold asterisk points out all advertisers in the Directory.

SECTION C

MANUFACTURERS' CATALOGS AND SALES OUTLETS—Manufacturers' advertising is arranged in alphabetical order. An index to these specification ads lists manufacturer's name and address of main plant; names and location of U.S. and Canadian representatives.

SECTION D

FLUID POWER DESIGN—224 pages of engineering reference material is divided into: JIC and ASA Standards, Nomographs, Design Data, Air and Oil Circuits. Product Information, and Applications and Developments.

SECTION E

WHERE TO BUY LOCALLY—The "Yellow Pages" supply information about local fluid component suppliers. Listing is alphabetical by state, city and company name. Advertisers in this section are independent sales companies.

. . . FLUID POWER APPLICATION!

. . . . . MASTER CATALOG OF FLUID POWER PRODUCTS

The only complete Hydraulic and Pneumatic Reference

YOUR HANDBOOK FOR FLUID POWER —This biennial volume—the 1958/59 edition—will be available October 28th. Since June 1955, the editors of APPLIED HYDRAULICS have been gathering and editing hydraulic and pneumatic information for this book. You will use the new edition of the FLUID POWER DIRECTORY as a time saver for all kinds of information about hydraulics and pneumatics.

The Components Directory Section lists more than 650 companies who manufacture products in the 140 indexed classifications from accumulators to wiper rings.

In this permanently bound volume, more than 150 manufacturers of fluid power components put their specification-type advertising in your hands—many will include condensed catalog information. Your 1958/59 Directory warrants being called the "bible" of fluid power application and engineering.

FOR ENGINEERS WHO USE FLUID POWER —When you're looking for sources of components, or trying to locate the manufacturer of a part for which you have the trade name, or want to quickly locate the local source, or need spec data immediately, it's all in this book. And you have a big PLUS section which is only available in this volume—224 pages of Fluid Power Design information. It includes JIC and ASA Standards, nomographs, charts, product information, over 150 circuits, applications and developments.

UP-TO-DATE INFORMATION —17,500 1958/59 Directories will be put in the hands of men who select fluid power components. A recent survey made to users of the first edition published two years ago shows that each copy is used by more than 5 men. The book is designed for the hard use it gets. It helps every user save time in designing and building fluid powered equipment. Your copy will be your fluid power handbook.

You can reserve a copy now . . .

$6.50 PER COPY

PUBLICATION DATE

OCTOBER 28, 1957

Compiled and Published by

APPLIED HYDRAULICS

The Magazine of Fluid Power

812 HURON ROAD

CLEVELAND 15, OHIO

FLUID POWER DIRECTORY
812 Huron Road, Cleveland 15, Ohio

Please reserve ..... copy (ies) of the 1958/59 edition priced at $6.50 a copy.

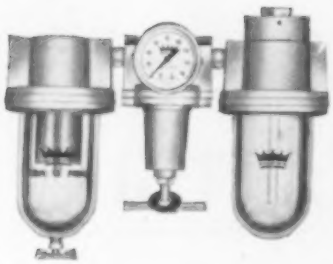
☐ Check enclosed ☐ Bill me

Name: ..... Title: .....

Company: .....

Address: .....

City: ..... Zone: ..... State: .....



NEW *Crown*
BULLETINS
TELL HOW...

Hannifin's newest development, the Crown Line of FILTERS, REGULATORS and LUBRICATORS, saves money wherever air power is used. The filters remove dirt and scale without robbing you of precious power. The regulators let more air through when it's needed than other regulators do. The lubricators operate on minimum pressure differential—they are quicker and easier to fill, too. Available now—local, distributor stocks in many areas. Write for bulletins and for name of nearest distributor.

"COMBO" UNITS
Bulletin 300

REGULATORS
Bulletin 301

FILTERS
Bulletin 302

LUBRICATORS
Bulletin 303

COMPLETE RANGE OF SIZES

HANNIFIN

FILTERS • REGULATORS • LUBRICATORS

Hannifin Corporation
545 S. Wolf Rd., Des Plaines, Ill.
Send me your Crown Bulletins and name of nearest distributor.

Name.....
Position.....
Firm.....
Address.....
City.....*State*.....

BRIEFS continued

interested or engaged in the training of individuals in this field.

The organizational meeting was held at General Motors Institute, Flint, Mich., and the principal speaker was F. L. Mackin, chairman of the machine shop and hydraulic department of the Institute. Program chairman for the next meeting, in October, is Dudley Pease, faculty member of Henry Ford Community College.

Information concerning membership in the Association may be obtained by writing George K. Tinetti, Executive Secretary, General Motors Institute, Flint 2, Michigan. ▼▼▼

Continued on page 42

BRIEF NOTES

RESERVOIR PAINT . . . which is unaffected by most hydraulic fluids, (including the phosphate ester type), is manufactured by Protex-A-Cote Inc., Newark. The coating, called Porselon, is applied like ordinary paint.

HYDRAULIC TRACK ADJUSTERS . . . are being installed as standard equipment on the Caterpillar Tractor Co. model D7 tractor, for use with the MD7 pipelayer. A hand grease gun is the only tool necessary to maintain proper tension.

NEW LINE . . . of medium and high-pressure cylinders, plus an all Teflon-sealed cylinder is being made by Miller Fluid Power. They have upped pressure ratings on all their high pressure cylinders.

PROTOTYPES . . . of rubber and plastic parts for experimental engineering purposes are produced by Minnesota Rubber and Gasket Co., Minneapolis. Their Kotokast technique cuts costs where prototype experimentation is necessary prior to actual production.

LOW-HEAT HYDRAULIC SYSTEM . . . Using a pressure-compensated, variable-delivery system, Thompson Grinder Co., Springfield, Ohio, has developed a hydraulic system which can operate continuously at, or slightly above, ambient temperatures.

BUSINESS BRIEFS

PRICE REDUCED ON TEFLON RINGS . . . W. S. Shamban & Co., Culver City, Calif., announced a 50% reduction on single turn back-up rings and washers. A new manufacturing process made the reduction possible.

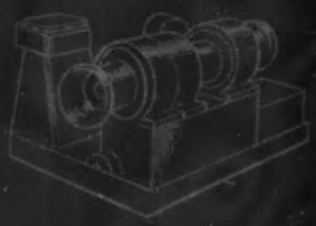
AIR FORCE CONTRACT . . . has been awarded to Republic Aviation Corp. for the study and design of a 1000 F hydraulic system. They will also study and develop high temperature hydraulic fluids for the system.

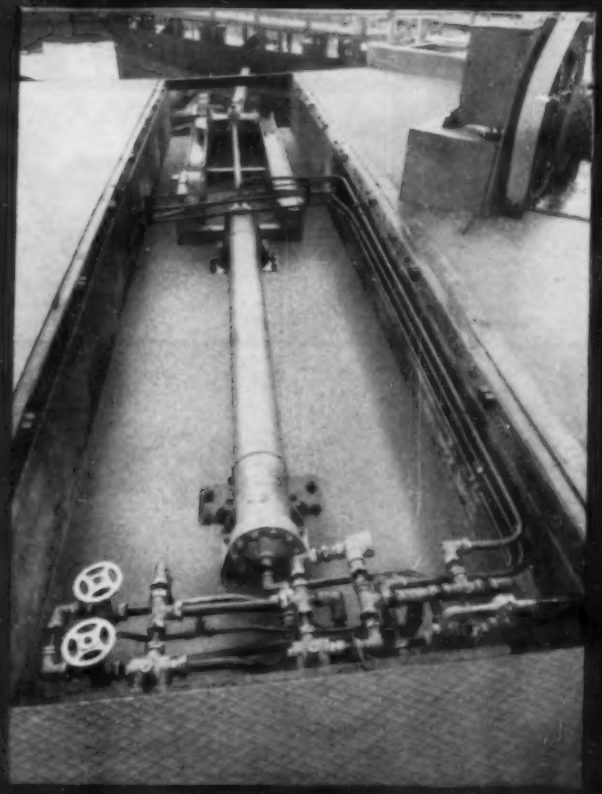
TELETYPE NETWORK . . . installed by Valvair Corp., Akron, links regional sales offices and its Canton, Pa. plant with Akron headquarters. Installed to speed order processing and product shipment, the system cuts order transmittal time to minutes.

CROSS-LICENSING . . . of Teflon hose fitting patents was announced by Albert J. Weatherhead, Jr., president of The Weatherhead Company, Cleveland. Under the agreement, Aeroquip Corporation of Jackson, Michigan will produce and sell permanently attached Teflon hose fittings, and Weatherhead will manufacture and sell Aeroquip re-usable type Teflon hose fittings.

FOR EFFICIENT POWER TRANSMISSION

Keelavite HYDRAULICS





A comprehensive standard range of hydraulic power and control equipment backed by circuit design, installation and after-sales services.

The hydraulic power unit illustrated is one of two supplied and installed by Head Wrightson Processes Limited to the order of the Dock and Harbour Authority, Hartlepool, for the control and output of a hydraulic electro-servo system illustrated [illegible] one of the four power operating cylinders and its control unit.

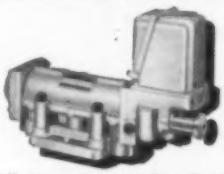
KEELAVITE ROTARY PUMPS & MOTORS LTD., ALLESLEY, COVENTRY
Telephone: Meriden 441

REQUESTS FOR AGENCIES THROUGHOUT THE U.S.A. WILL BE WELCOMED

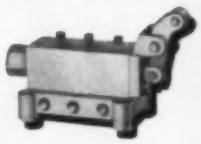
THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANSMISSION

Get more production—at lower cost with

Quick-As-Wink®
AIR AND HYDRAULIC
Control Valves

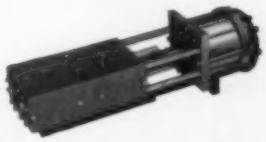


½" Single Solenoid Two Position 4-way "B"-type Valve, for Pressures up to 250 psi.



¼" 4-way Cam Operated Spring Return Valve, for Pressures up to 125 psi.

½" 2 Pedal Foot Operated 4-way Valve, for Pressures up to 200 psi.

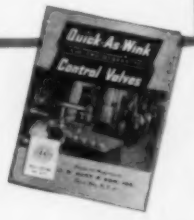


1" Pilot Cylinder Operated 4-way Two Position Hydraulic Valve, for Pressures up to 5000 psi.

Cut your costs—and increase your production—by installing Quick-As-Wink Control Valves **throughout your plant.** Proven in service, our exclusive, patented* construction assures year after year of long, efficient, dependable **and low cost operation.** Production and maintenance men know Quick-As-Wink Valves are unsurpassed. Can you afford to gamble with less? Hundreds of different types, actions and sizes from ¼" to 4". Get full details.

*U. S. Patent No. 2,645,450

Write for **BULLETIN NO. 571** *Today.*



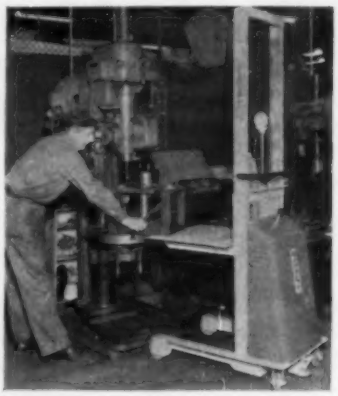
Quick-As-Wink®
AIR AND HYDRAULIC
Control Valves

***Mfd. by* C. B. HUNT & SON, INC., 1993 East Pershing St., Salem, Ohio**
— Engineering and Sales Representatives in the Principal Cities —

BRIEFS continued

Portable Hydraulic Elevator

The hydraulic system for raising the platform is designed to maintain low pressure under maximum loads, assuring minimum wear on packings. A by-pass return



oil line to the reservoir prevents oil leakage.

The hydraulic system is a complete package unit, powered by automotive type batteries of 12 volt capacity.

Unit will lift 750 pounds 71 inches in 9.5 seconds. In designing the machine, Barrett-Cravens Co., Northbrook, Ill., included every safety feature. ▼▼▼

Emergency Air Brake Has Sealed-In Air Supply

An emergency air-brake-control system for buses, trucks or truck and trailer combinations features an air supply that is entirely independent of the vehicle's main air supply. It operates only when the main air supply is lost or lowered to a point below safe operating pressures. It can be installed so that the brakes will apply in several combinations; axle by axle, chamber by chamber, rear axle only, front and rear axles or any other combination of needs.

If a driver attempts to move his truck without adequate air pressure in his main system, the

Continued on page 44

ALEMITE

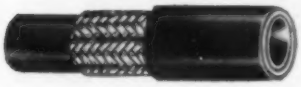
SURGEPRUF

reusable couplings *and* hydraulic hose

• for fastest in-the-field replacement!

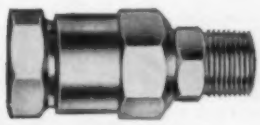
• first choice for original equipment!

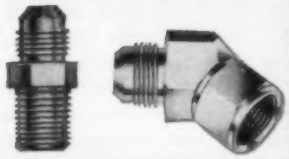
Single and Double Wire Hose For Medium-High Pressure and High-Pressure Service



Seamless inner tube of synthetic rubber, reinforced steel wire braid, and synthetic rubber outer cover. Resists abrasion, weather, and oil. Hose temperature operating range: —40°F. to +275°F.

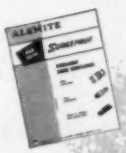
Couplings. Made of high-strength steel. "Double-wedge grip" forces coupling threads through rubber cover . . . grips either single or double wire braid firmly. Saves both time and labor!





Adapters. Full range of sizes in J.I.C. and other threads. One-piece adapters—and swivel union adapters to simplify assembly and avoid twisting strain in cramped quarters.

Hose Assemblies. Types and sizes for all hydraulic lines. No special assembly tools required. Fast, easy assembly with just ordinary tools!



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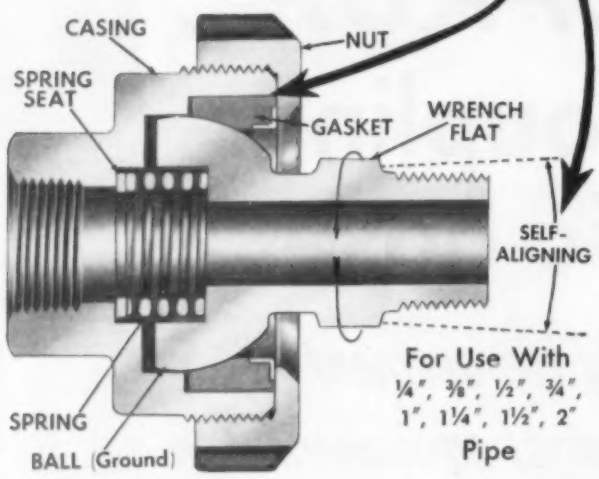
1. Self-Aligning Ball
2. Self-Adjusting Seal



BARCO SWIVEL JOINTS

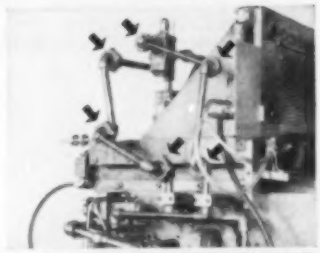
—Make Piping Flexible!

Two important features give Barco Swivel Joints capabilities not found in ordinary swivel joints:

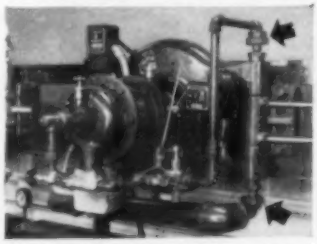
SELF-ALIGNING—Provides a wide tolerance for pipe fitting and machine alignment. Saves endless hours installation time and permanently protects against binding and wear.

SELF-ADJUSTING SEAL—Pressure sealing and automatically self-adjusting for wear. Ideal for hydraulic service. Uniform performance over wide temperature range. Long life. No lubrication needed.

Send for Catalog 265B, "Barco Self-Aligning Swivel Joints." Ratings as high as 750 psi steam or 3000 psi hydraulic. Sizes ¼" to 2"; angle or straight. *Ask for recommendations—Barco is at your service.*



15,870 HOLES PER MINUTE—Six Barco Swivel Joints (see arrows) in "dog leg" piping provide flexible connections to moving hydraulic cylinder on acoustic tile hole drilling machine. 800 psi operating pressure; ¾" to 1" stroke, 30 per minute.



OIL BURNER—Two Barco Swivel Joints (see arrows) mounted as pivot points on hinge provide swivel connections for fuel oil and steam atomizing lines to door mounted oil burner.

FOUNDED 1903 BARCO PRODUCTS BACKED BY EXPERIENCE

BARCO MANUFACTURING CO.
532K Hough Street • Barrington, Illinois

The Only Truly Complete Line of Flexible Ball, Swivel, Swing and Revolving Joints
In Canada: The Holden Co., Ltd., Montreal

BRIEFS continued

emergengy brakes will apply immediately. The air compressor will start pumping air to the main system. When this pressure reaches the normal operating pressure, the emergency brakes will release. The action of the emergency control valve is automatic, but not severe. The braking action is ratio-controlled. If a fast or sudden loss of air occurs, the valve delivers only enough air to accomplish its braking action. The emergency system installation is simple, and does not require any changes in the present air system. It is manufactured by Power Brake Equipment Co., Portland, Oregon. ▼▼▼

Recent Publications

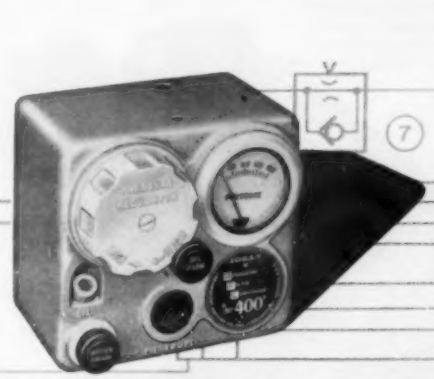
Automation in Practice, by Samuel E. Rusinoff. This book explains the use of automatic controls and pneumatic, hydraulic, electrical and electronic controls devices, shows how automation may be used in production of metals, metal casting, pressworking, metal-cutting operations, heat treatment of metals, testing, inspection and quality control.

Rusinoff, an authority on manufacturing processes, is now a professor in mechanical engineering at the Illinois Institute of Technology, and a private consulting engineer. He has been in design and research at Westinghouse Electric, Borg-Warner, and an automobile manufacturer, and has written several other books and articles on manufacturing processes and production. ▼▼▼

Automatic Controls Standard Being Developed

Increased use of automatic controls in industry has created a need for a common language for this field of engineering effort. Under the auspices of the Ameri-

Continued on page 48



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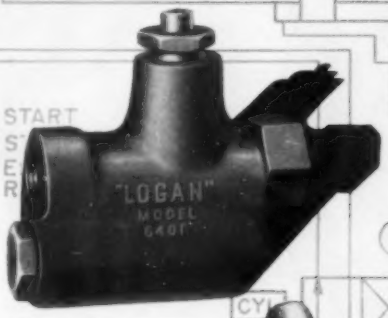

LOGAN MODEL 6401
ADJUSTABLE AIR SPEED
CONTROL VALVE

LOGAN MODEL 6540 4-WAY, 2-POSITION
AIR CONTROL VALVE

Yes, you can always depend on Logan for the most dependable components to effectively serve your air circuit requirements.

FREE *SEND FOR THE "LOGAN CALCULATOR"*

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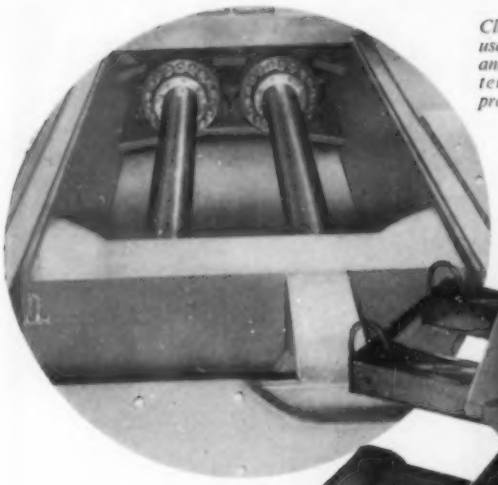

Close up of Acipco steel tubes used as hydraulic cylinders and rams in the new Dempster-Balester scrap metal press.

New Dempster-Balester "750" features the Auxiliary-Compression Door and Skip-Pan Loader. New, longer charging box handles scrap as large as a complete auto body.

ACIPCO

Centrifugally Spun

STEEL TUBES

Selected for Newly Developed Press

Dempster Brothers, Inc., of Knoxville, Tennessee, is one of the country's leading manufacturers of baling equipment. They also manufacture equipment in the famous Dempster-Dumpster System of materials handling.

When Dempster Brothers' engineers required powerful hydraulic cylinders for their new "750" Dempster-Balester, they called on Acipco. Working with Dempster Brothers' creative engineering staff, Acipco supplied the two main hydraulic cylinders, completely fabricated and assembled, for this new, more economical press.

The Dempster-Balester main cylinders are examples of the extra advantages you get when you specify Acipco centrifugally spun steel tubes for your application. In addition to getting high quality tubes with the exact physical, metallurgical and chemical properties your application requires, you get the benefits of expert technical assistance and Acipco's combination of complete facilities and manufacturing competence.

If you manufacture or design products requiring tubular steel, your nearest Acipco distributor will be glad to supply information about Acipco steel tube applications in your field.

Hydraulic cylinders fabricated of Acipco steel tubes ready for shipment.

SIZE RANGE: Lengths up to 16′— longer lengths by welding tubes together. OD's from 2.25″ to 50″; wall thicknesses from .25″ to 4″

ANALYSES: All alloy grades in steel and cast iron, including heat and corrosion resistant stainless steels; plain carbon grades and special non-standard analyses.

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ACIPCO
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Strong, Carlisle & Hammond Co.
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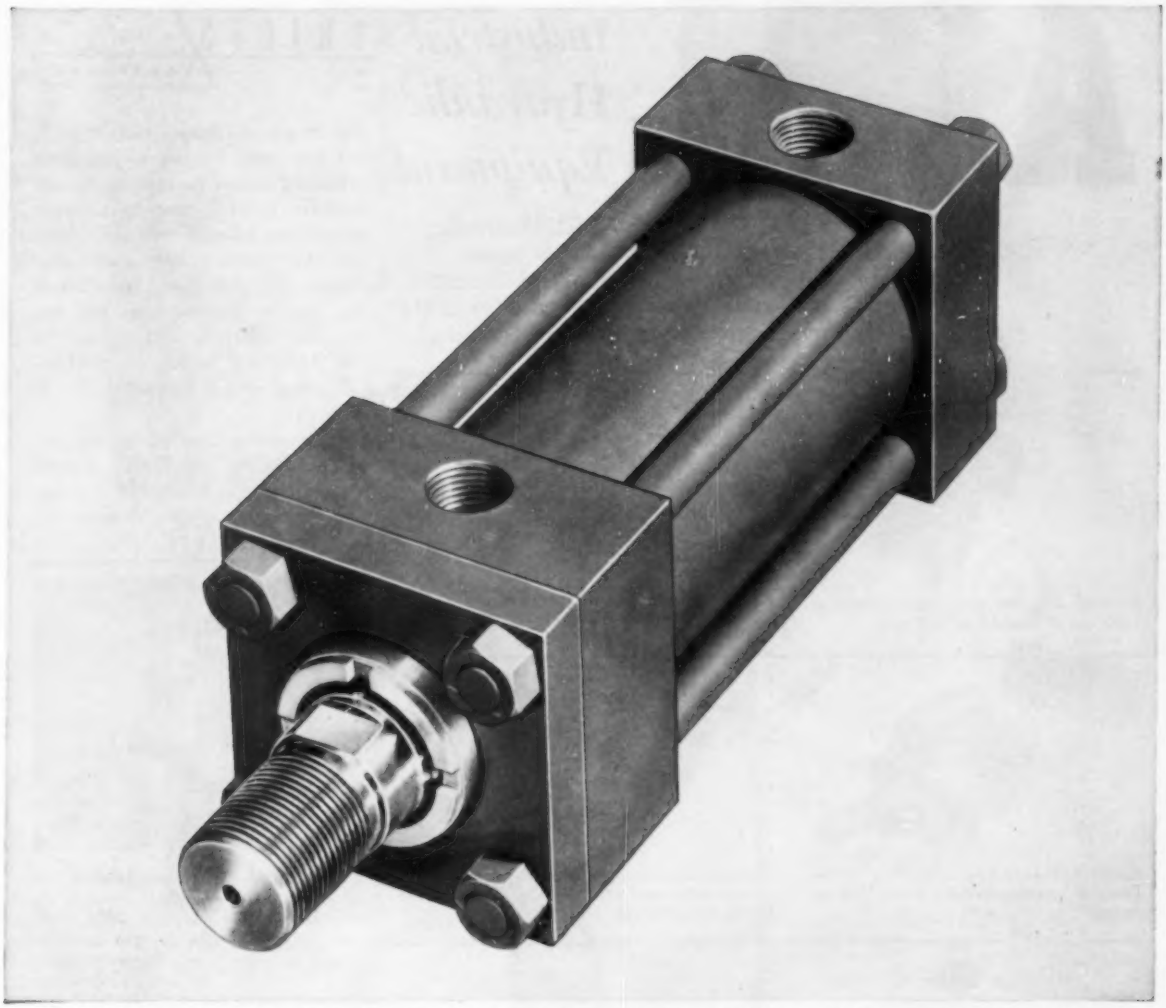

Hannifin, leader in fluid power products, has added an important feature to the cylinder—work horse of the hydraulic business. Their series "H" square-type cylinder (above) uses a unique removable cartridge gland... the gland is threaded for easy removal without dismantling the cylinder... also, the bronze bearing is ahead of the packing, where it receives adequate lubrication, gives longer gland life. With this feature, changing the rod packing is simple... for Pydraul, just order "Group 3" packings.

Engineers guard against needless fire risks with fire-resistant Pydraul in Hannifin cylinders

A hydraulic-fluid fire could destroy all or a vital part of your entire plant . . . good reason to use fire-resistant Pydraul. Needless risks are avoided . . . even if your hydraulic equipment is near hot metal, electrical contacts, or open flame, because Pydraul is fire-resistant. Pydraul has good anti-wear qualities and noncorrosive features to protect the satin finish of honed cylinder bodies (or any metal parts).

If you need a top-grade hydraulic fluid combining superior lubricating qualities . . . long service life . . . vital safety factors . . . see your Monsanto representative about Pydraul. He'll show you how easy it is to switch to fire-resistant Pydraul.

Write for Pydraul F-9 booklet
Organic Chemicals Division
MONSANTO CHEMICAL COMPANY
Dept. OEM-12, St. Louis 1, Missouri

Pydraul F-9—first and only hydraulic fluid listed by Underwriters' Laboratories "In respect to fire hazard, Pydraul F-9 is rated by Underwriters' Laboratories, Inc., 2-3 in a class much less flammable than a paraffin (petroleum) oil, according to a schedule in which Ether is rated 100; Gasoline 90-100; Alcohol (ethyl) 60-70; Kerosene 30-40; Paraffin 10-20."

Pydraul: Reg. U.S. Pat. Off.

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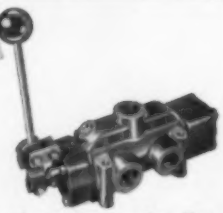
ADEL *Industrial Hydraulic Equipment*

for PEAK PERFORMANCE ADEL Hydraulic Valves and Pumps are setting new and ever higher standards for precision in manufacturing and efficient performance in operation. Following are but a few of the wide variety of models to meet all operating conditions.

GEAR-TYPE HYDRAULIC PUMPS

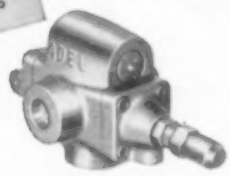
For 1000 psi service with rated capacities at 1800 rpm of from 1.5 to 46.8 gpm.

DIRECTIONAL CONTROL VALVES



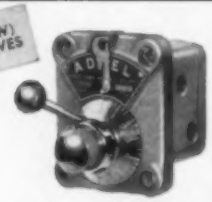
4-way valves with spring-centered, spring-offset, and 1, 2, or 3 position detent action. 1500 psi. Flows to 28 gpm.

BY-PASS VALVES



Relief, Sequence and Unloading valves. Direct or remote operation, 50 to 1500 psi range.

VOLUME (FLOW) CONTROL VALVES



Compensated type maintains constant flow over wide differential pressure range. No drain line required. 1500 psi.

PILOT VALVES

2 or 3 position detent. With or without dog or lever. Can be used as 4-way valve in small circuits. 1000 psi.

CHECK VALVES

Valves allow free flow in one direction only. Many variations available. 3000 psi.

Reliability

ADEL PRECISION PRODUCTS

A DIVISION OF GENERAL METALS CORPORATION

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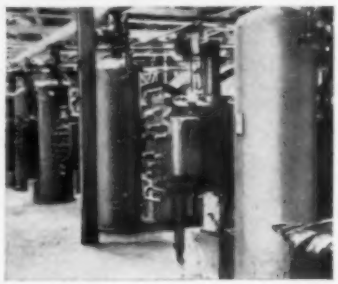
Seattle, Washington

BRIEFS continued

can Standards Association, a project has been started to establish standard terms pertaining to automatic control and to develop definitions of such terms. To handle this project, Sectional Committee C85 has been constituted. Its title is: Terminology for Automatic Controls. Its sponsor is the American Society of Mechanical Engineers. Its scope is as follows:

Terminology pertaining to systems such as: automatic process control, feedback control, regulating and other related systems not requiring human intervention as part of the regulating procedure.



On horizontal gas engines with integral air compressor cylinders, installed by Liberty Glass Co., Sapulpa, Okla, mechanical fatigue due to gas pulsation caused pipe line breaks. Burgess-Manning Co., Libertyville, Ill. designed snubbers to solve this pulse problem. They were installed in the 45 psig discharge laterals adjacent to each machine. Pulsation was reduced to a minimum and the vibration in the discharge headers and aftercoolers was eliminated.

The subcommittees and their work areas are as follows:

Subcommittee 1, Types and Components—definitions to describe the basic types of automatic control systems and the various component elements of each system.

Subcommittee 2, Signals—defining the signals and process variables which are present in a generalized feedback control system.

Subcommittee 3, Moles and Parameters—terms describing automatic control action, and the

Continued on page 50

halos...

for harassed engineers*

Are your leather oil seals or packings giving you headaches instead of halos? Your best cure for this situation – specify IPC.

Why?

Well, because IPC specializes in the custom approach to packings problems . . . leather or synthetic. Better materials and manufacturing techniques add up to better results.

You might be amazed at the applications which are solved by IPC leather packings – plain or impregnated. Ask your IPC representative for a complete rundown . . . *today*.

**Production and maintenance folks, too!*

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Bristol, New Hampshire

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JOHN S. BARNES CORP.	●		●
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THE CA[illegible] CO.	●		●
THE COMMERCIA[illegible] & STAMPING CO.	●	●	●
DOWTY HYDRAULIC UNITS LTD.	●	●	●
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Quick with the answers . . .

• • • that's the Designers' Guide Issue of APPLIED HYDRAULICS in January. It provides 34 Quick Guides to Product Selection to help hydraulic design engineers choose fluid power components . . . and a Fluid Power Products Review to help engineers develop new equipment. Make sure your copy is handy!

January Issue

APPLIED HYDRAULICS

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This special issue will be referred to all year 'round, giving your sales message extra readership. A complete name and address index helps readers find your company's ad. Forms close December 5th . . . regular space rates apply . . . order your advertising space today!

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BRIEFS continued

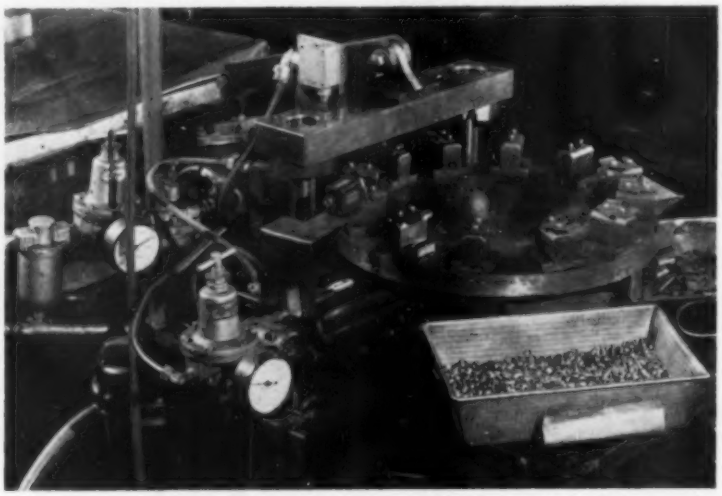
fixed or adjustable parameters which influence control action.

Subcommittee 4, Behavior and Presentation—defines terms describing in detail the responses of automatic control systems, and their generalized controlled elements.

A Coordinating Committee will resolve questions of concept, procedure and style as they affect all subcommittees. It will also serve as an editorial committee to draft the tentative Standard. ▼▼▼

Continued on page 52

Accurate Part Assembly With Air Circuitry



A machine has been designed to semi-automatically press two hardened bushings into a cutting chain router tooth. The operation was originally performed on standard arbor presses with special fixtures to pre-position the parts. Maximum production with the old system was 4800 assemblies per day. With the new equipment 2300 unit assemblies *per hour* is possible.

• **Operation**—Pushing the start button causes the 12 station rotary feed table to index one station. The impulse switch, built into the index table, actuates the air cylinder which presses the bushings into the tooth. When the air cylinder retracts, a switch indexes the table again, completing the first cycle of the continuous cycle operation.

• **Accuracy**—The depth the bushing is pushed into the router tooth is measured by a limit switch which controls the retraction of the air cylinder. The switch can be screw adjusted for various sized bushings. This switch will only retract the air cylinder if the proper bushing is used—all operation stopping if the bushing is the wrong size. The valve that directly controls air cylinder retraction will trip with only a .002 in. movement of the limit switch. This sensitive action means that the bushings are press fit to within .002 in., or flush with the router tooth body.

• **Advantages**—Even though two operators are needed to load and unload the machine, the maximum daily output is almost four times the old method. The accuracy of the air cylinder and electro-hydraulic control system has completely eliminated rework, a major disadvantage of the arbor press method. The new machine developed by Dunnington Mfg. Co., Indianapolis, paid for itself after 90 days operation. ▼▼▼

SECO ISO-FLO PUMP

Several *isolated* flow outputs from the same pump...

SOME *IDEAL* APPLICATIONS

IDEAL for parallel feed of cylinders.

IDEAL in accumulator applications. No delicate pressure balance valve is required. All pistons deliver power to charge the accumulator; then one piston maintains pressure. System leakage is supplied by this same piston discharging over the pressure control valve. Minimum horsepower is used and constant cycling is avoided.

IDEAL for clamping or other high-low operations requiring only maximum and minimum power. Makes unnecessary the use of both a high pressure and a low pressure pump, or a costly variable displacement arrangement. The single ISO-FLO pump is both better suited and more economical.

The ISO-FLO pump is actually *many* separate radial piston pumps in one pump body. Though all piston assemblies are driven from a common eccentric cam, each piston has its own set of valves. Thus each piston is in itself a highly efficient source of fluid power, which may be *isolated* from the output of the several other pistons—by a simple alteration of the pump's normal discharge manifold. A variety of independent flow rates may thus be obtained from a single ISO-FLO pump, without complex flow control or reducing valves.

By subjecting the various independent flow rates to control by separate relief or pressure control valves, *one* ISO-FLO pump can easily be made to handle a variety of hydraulic operations—without the complex valving of the usual control systems, and without the cost of secondary pumps and motor drives.

ISO-FLO pumps are available in models with 7 or 14 pistons. Capacities: ½ to 10 G.P.M. Operating pressures over the entire 0 to 10,000 PSI range.

SECO FLUID POWER

SIMPLEX ENGINEERING CO.
Subsidiary of RACINE HYDRAULICS & MACHINERY, INC.
ZANESVILLE, OHIO

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These PLUGS & CAPS are easily hand tightened

For
- Pressure Seal
- Thread Protection
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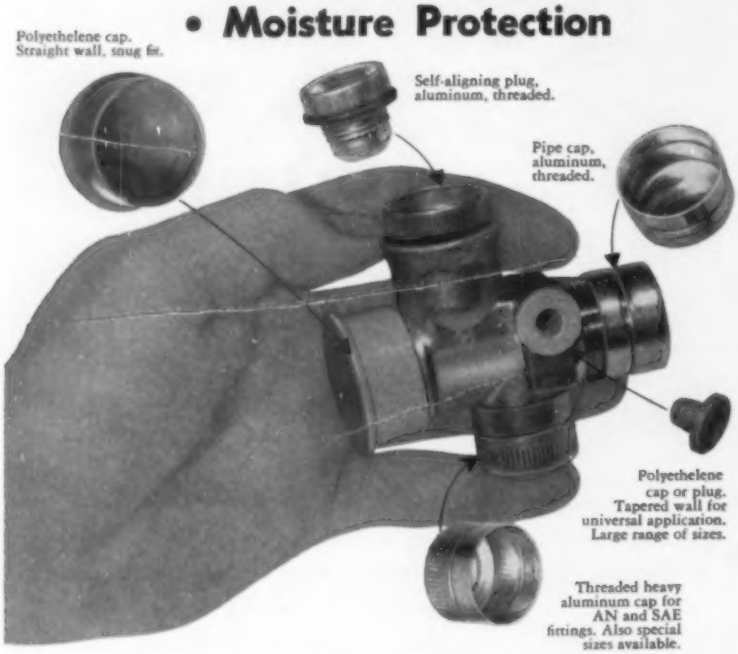
Polyethelene cap. Straight wall, snug fit.
Self-aligning plug, aluminum, threaded.
Pipe cap, aluminum, threaded.
Polyethelene cap or plug. Tapered wall for universal application. Large range of sizes.
Threaded heavy aluminum cap for AN and SAE fittings. Also special sizes available.

When you buy Clover Closures you buy the best in tight fitting protection. They are made in polyethelene and metal for internal and external applications. Tight fitting design, seals out moisture, dirt and gives dependable thread protection. Metal closures with neoprene rings or discs can be used to seal unit and hold relatively high pressures. For the newest in closures always specify CLOVER! Special closures engineered to your requirements.

Threaded aluminum caps and plugs with large knurled grip for fast hand application. Shows use of neoprene to seal pressurized systems.

This new polyethelene closure has heavy molded threads. It fits the contour of the part and when set up by hand will maintain pressure in a system while protecting threads.

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Gentlemen:
Please send your idea box of Clover Closures.

Name_____
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I am interested in:
Plugs ☐
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In Metal ☐
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With Neoprene seal ☐
Thd. Size_____

BRIEFS continued

Denison Sets Up Research Foundation

A research organization to serve industry and the U. S. Government by providing research talent and facilities for conducting a wide variety of research, has been announced by William C. Denison, chairman. The Denison

W. C. Denison

Research Foundation, located at 8555 Olentangy River Road, Columbus, is a phase of the William C. Denison Foundation, formed in 1941.

Jack P. Pedersen, former executive of Detroit Harvester Co., Detroit, has been appointed director, and Robert R. Hyatt, former general counsel and administrative staff assistant for Denison Engineering Co., was appointed associate director.

In addition to its full time staff, the Foundation has a supervising board of consultants made up of prominent scientists. ▼▼▼

Air Powered Hand Tool Fastens Hose Clamp

Improvising with available equipment, J. N. Fauver Co., Detroit, has air powered a manual clamping tool to speed the assembly of hose clamps on air lines. A 2-in. diameter air cylinder, operating at 40 psi, is used to actuate the clamping tool. With one arm welded to the base plate, and the other welded to the cylinder shaft, the tool is controlled

Continued on page 54

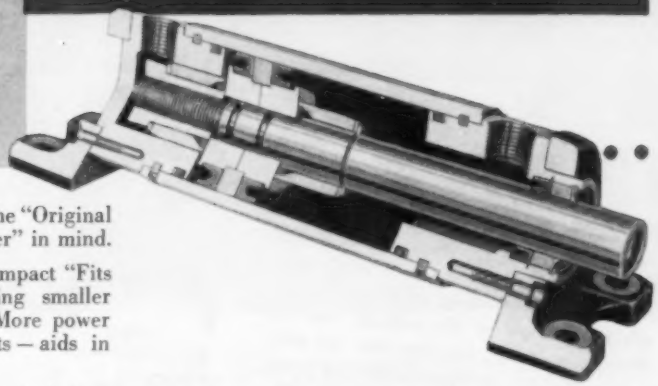
O-M Built-in QUALITY

Means Built-in ECONOMY

O-M Tie-Rodless Cylinders 150 PSI Air– Up to 1500 PSI Oil

Meet JIC Standards

Fit Where Others Won't!



O-M cylinders were designed with both the "Original Equipment Manufacturer" and the "User" in mind.

Space-Saving — O-M is the original compact "Fits where others won't" cylinder, allowing smaller castings to be used in machines, or "More power for same space"— easily oriented ports — aids in design problems.

Best of Materials — Precision honed steel barrels, bronze bearing surfaces, machined steel end covers, highly polished chromed piston rods, rod scrapers, proper packings for the various operating mediums and pressures — just to mention a few.

Long Life — Quality material, accurate machining, fine finished, proper bearing materials, precision assembly, individual testing are assurance of long life.

Easy Maintenance — The internal key feature not only makes it possible to save space and to easily orient ports, but also makes it easy to disassemble, inspect, clean, repair and reassemble—thus further reducing costly down-time.

Original Cost — Priced right! Compare prices and quality to be convinced.

O-M Air and Hydraulic Tie-rodless Cylinders are available in a complete range of sizes (1½" to 8" bores) with standard or heavy duty rods. Completely interchangeable parts and mounts. Immediate delivery on many sizes.

Mail coupon at once for Bulletins 101A (O-M Tie-Rodless Air and Hydraulic Cylinders) and 105 (O-M Series T-H — Heavy duty Hydraulic Cylinders)

Engineering Service

Consult an Ortman-Miller representative regarding your pneumatic and hydraulic problems. His broad experience with standard and special cylinder applications is available to you without cost or obligation. Use convenient coupon for name and address of O-M representative nearest you.

ORTMAN-MILLER MACHINE COMPANY

1 143rd Street, Hammond, Indiana

☐ Have representative call

☐ Send Bulletins 101A and 105

Name_____ Position_____

Company_____

Address_____

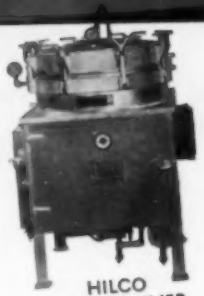
City_____ Zone____ State_____

Keep YOUR HYDRAULIC SYSTEM Clean with HILCO HYDRAULIC OIL FILTER

- No More Varnish and Sludge Deposits
- No More Flushing and Manual Cleaning
- No More Frequent Oil Changes
- No More Accumulation of Dirt

Filter life up to a year eliminates usual frequent draining, refilling of systems.

HILCO Hyflow Oil Filters trap dirt, acids, rust, sludge, gums, resins . . . all solid contaminants, and keeps your hydraulic system clean and in top running condition at all times. To you, this means longer oil life, reduced wear and abrasion . . . hence, less down time and lower maintenance costs giving you continuous equipment operation with increased production. Hydraulic unit sensitivity depends upon a clean system. HILCO Hyflow filters remove solids as soon as they enter the system and retain much of the moisture which enters the oil from the atmosphere and from condensation. Obtain the full capacity and economy of your equipment by keeping it in top running condition with HILCO. Hydraulic Oil Filters come in stationary or portable models. They can be hooked into hydraulic systems without interrupting equipment operation.



HILCO OIL RECLAIMER

For complete oil reclaiming. Removes solids, acids and volatile impurities; moisture, solvents, gasses, etc., from hydraulic fluids by heat-vacuum process.

• SEE FOR YOURSELF HOW HILCO keeps your Hydraulic System Clean . .

WRITE TODAY FOR THIS *Free* BOOKLET

Recommendations at no Obligation

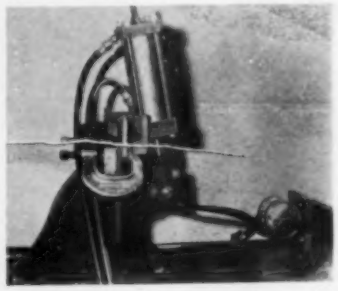
THE HILLIARD *Corporation*

148 W. FOURTH ST. • ELMIRA, NEW YORK

IN CANADA: [illegible]

BRIEFS continued

by a four-way, foot operated valve. The hose clamp design lends itself to this mechanical application. Manufactured by Circle Clamp Corp., New York, these one-piece, round clamps have two lugs on opposite sides. The clamps



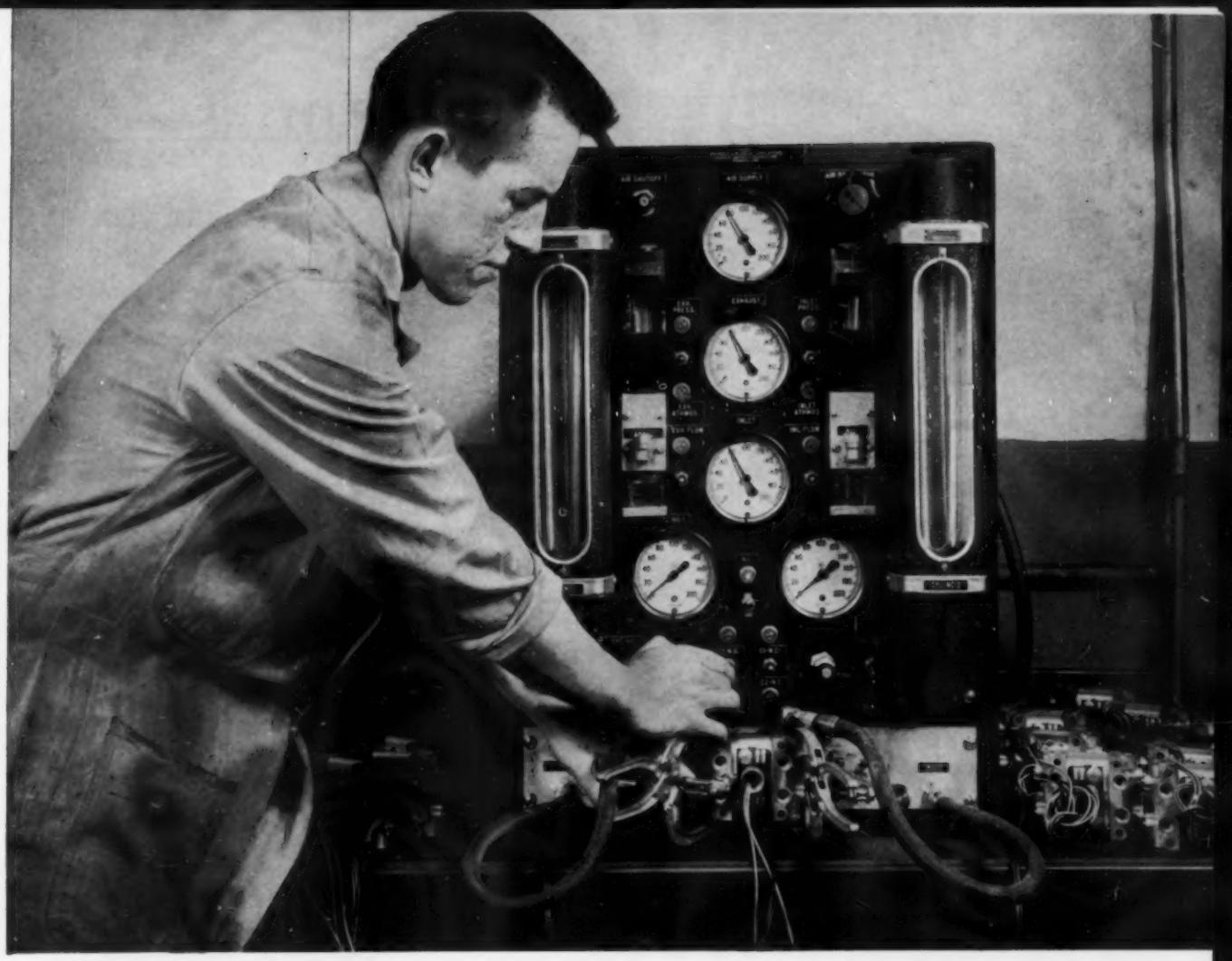
are applied by squeezing the parallel sides of the lugs together with pincers. The operator slips the clamp on the hose, and holds it inside the receiving rings so the pincer jaws close on the lugs. No slippage or loss of clamping action has been observed at hose burst pressure—approximately 12,500 psi. ▼▼▼

Continued on page 56

This air valve testing unit employs a single solenoid spring return valve with an electrical timer control. The reading dials on this control denote the speed in piston strokes per minute that the valve is operating. On the same table is a momentary-operated valve connected to a double-acting cylinder. This valve is hand operated by two hand switches. The testing unit was developed by Ross Operating Valve Co., Detroit.

Circle 74 on Reader Service Card

Circle 137



The 100% testing of all Skinner Solenoid Valves is your guarantee of consistent leakproof life

Every single Skinner Solenoid Valve receives 100% leakage inspection before shipment. Each one is tested under full pressure conditions at every point for both internal and external leakage. Modern, sensitive equipment like that shown above is used to quickly detect any defect.

In laboratory tests Skinner valves are regularly getting over 20 million cycles without leakage. And these remarkable results are constantly proving out in service.

In vacuum service, for example—and in critical test equipment—standard Skinner valves are frequently specified because of their record for outstanding trouble-free performance.

So, if you are looking for solenoid valves with exceptionally long leakproof life, look to Skinner valves. For complete information on Skinner's line of 2-, 3- and 4-way valves, write us or contact a Skinner representative. Write Dept. 319.

Skinner Solenoid Valves are distributed nationally

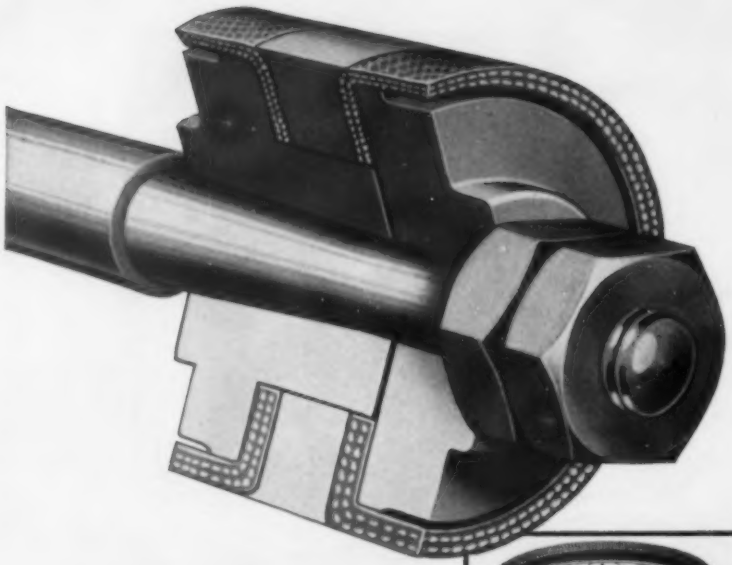
SKINNER ELECTRIC VALVES

THE CREST OF QUALITY

SKINNER ELECTRIC VALVE DIVISION

NEW BRITAIN CONNECTICUT

105 EDGEWOOD AVENUE



WHY PUMCUPS MAKE A DIFFERENCE

Darcova Pumcup

Darcova 45° Bevel Type Pumcup

- **in reciprocating pumps**
- **in air and hydraulic cylinders**

With Darcova Pumcups in your cylinders, there's less fluid slippage. High volumetric efficiency is maintained and Pumcups outlast other packings at least 3 to 1! There's less down-time! Lower power cost! Smoother operation! Less maintenance and replacement!

Longer life is the result of truly advanced cup engineering, including 100% nylon composition, plus a choice of types, textures and precision sizes to exactly match fluid, cylinder, pressure and temperature conditions.

These same factors contribute to prolonged high efficiency by permitting full advantage of the "cup principle". Thus fluid pressure always keeps Pumcups snug against cylinder wall, despite eventual wear, while the total frictional load is minimized.

Send for Bulletin 5503. It will give you *all* the facts.

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

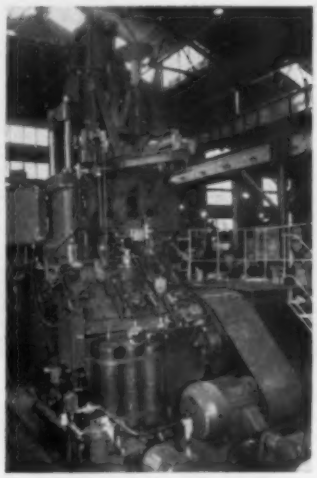
DARCOVA
THE ORIGINAL COMPOSITION CUP

TRADE MARK
PUMCUPS

BRIEFS continued

Fluid Powered Press For Powdered Metals

Pressing parts from powdered metals is not too difficult if you have a press like the one developed by Baldwin-Lima-Hamilton Corp., Philadelphia. The head of the press is a cylinder with its piston connected to the top punch support. Oil is held in the cylinder above the piston, and an accumulator is mounted on the head. A hand pump gets oil to the head. Head pressure is obtained by charging the accumulator with air or nitrogen. By using this



floating head principal, it is possible to predetermine what pressure will be applied.

The die holder is positioned by two regulated air cylinders. Adjustable stops limit the travel of the die when pressing flanged parts. Mountings hold two core rods simultaneously. One mounting is stationary; the other is movable, positioned by a pneumatic cushion.

All moving, lubricated parts are enclosed, to prevent abrasives from getting into the bearings. A gear pump forces filtered oil to the crank and connecting rod bearings.

The press may be cycled for continuous run, dwell at any predetermined point, single stroke, and inching. ▼▼▼

The "Outboard Motor" Principle Applied to Hydraulics . . .

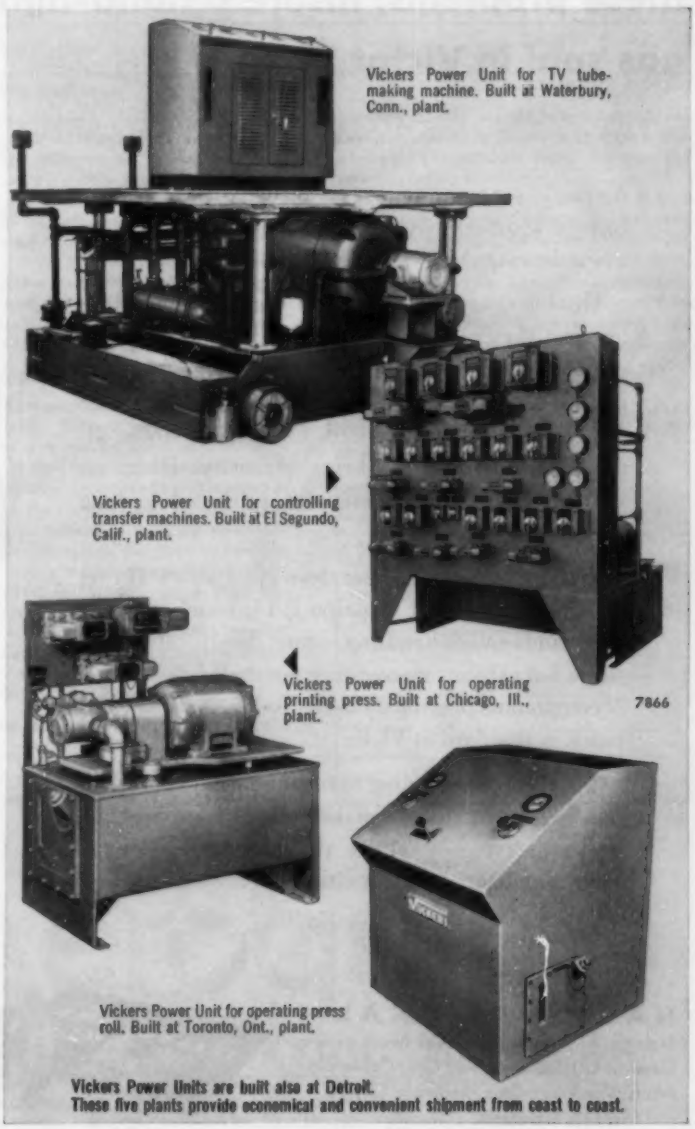
VICKERS® "Packaged" Hydraulic Power Units Are Compact, Convenient and Economical

The outboard motor is popular because it is a complete, self contained power package . . . quick and easy to apply.

Vickers Custom-Built Power Units provide a comparable packaged system for the hydraulics of any particular machine or job. Built to the exact needs, it is compact, efficient, and very quick and easy to apply.

All necessary pumps, valves, intermediate piping, motors, controls, oil reservoir, oil filters, air cleaners, oil level gauges, fittings, etc. are included, as well as electronic components if used.

You are assured dependable performance. Design is improved and simplified, time and cost of installation are reduced, appearance is better, servicing is easy. Each unit is pretested at the factory and is ready for immediate operation. Vickers undivided responsibility for the entire hydraulic control system is important to both the machine builder and his customer. Write for Bulletin 52-45.



Vickers Power Unit for TV tube-making machine. Built at Waterbury, Conn., plant.

Vickers Power Unit for controlling transfer machines. Built at El Segundo, Calif., plant.

Vickers Power Unit for operating printing press. Built at Chicago, Ill., plant.

7866

Vickers Power Unit for operating press roll. Built at Toronto, Ont., plant.

Vickers Power Units are built also at Detroit.
These five plants provide economical and convenient shipment from coast to coast.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1474 • Detroit 32, Michigan

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IN CANADA: Vickers-Sperry of Canada, Ltd., Toronto and Montreal

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

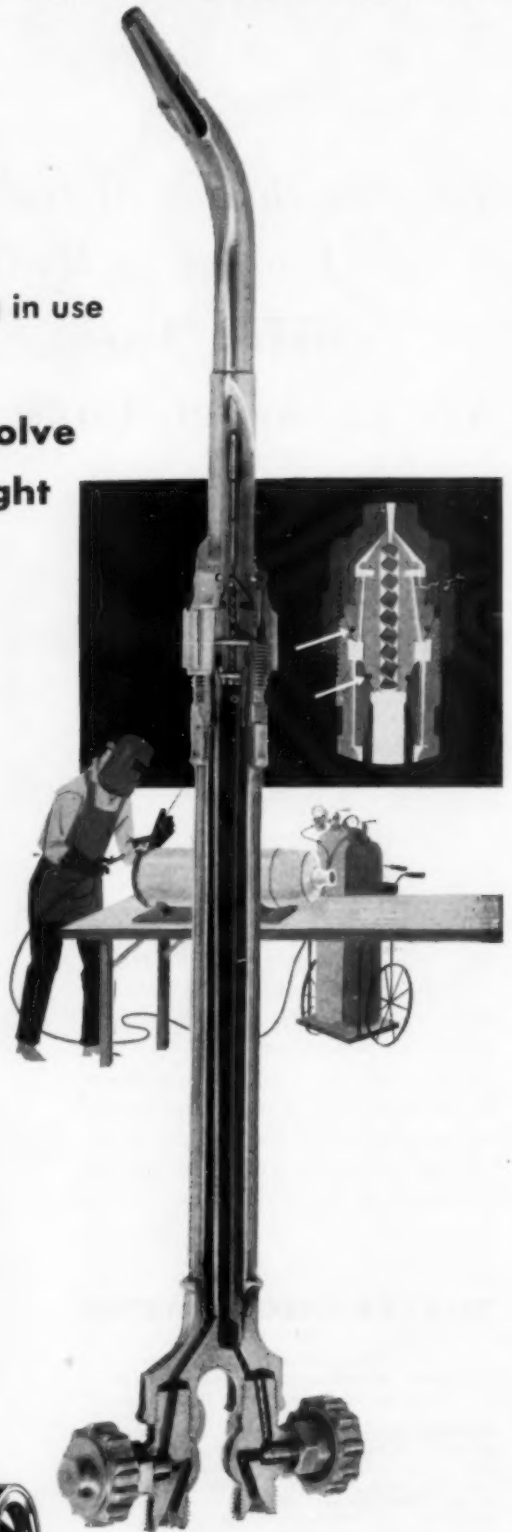
Ozone deterioration

Continuing stress

Gas leakage

Rough handling in use

New National Hypalon O-rings solve these problems; insure a hand-tight gas seal in Victor Torches



As static seals, commercial Buna N O-rings performed satisfactorily in Victor welding torches — *when the rings were new.*

However, ordinary O-rings age fast in welding torches. They receive rough treatment when welders change nozzles; nozzles are often dropped on the ground to lie there until needed again. Severe ozone deterioration is experienced. Continuing stress, although mild, impairs O-ring elasticity. Rings on welding nozzles are sometimes subjected to long shelf life.

National Seal engineers developed a new O-ring compound, National Hypalon L-11, which not only withstands rough handling, ozone deterioration and stress but exhibits many times the shelf life of Buna N compounds previously used. Today, National Hypalon is standard at Victor.

Special compounding to meet unusual conditions is a basic part of National's complete O-ring engineering service — service available from National Field Engineers in major cities nationwide.

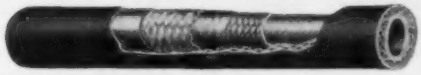
NATIONAL SEAL
Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
Plants: Van Wert, Ohio, Redwood City and Downey, California

4374

Circle 109 on Reader Service Card

Specify These Aeroquip Hose Lines For Fluid Line Systems Up To 3000 psi.*

AEROQUIP 1503 AND 1502 HOSE is constructed with a synthetic rubber inner tube, a reinforcing layer of single wire braid, and an oil and mildew resistant cotton braid cover. Tube sizes from ¼" through 2½".



AEROQUIP 2651 AND 2652 HOSE features the same tough construction as 1503 Hose, but has an oil, mildew and abrasion resistant rubber cover. Tube sizes from ¼" through 3".

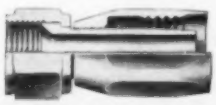
Dash size (in 1/16 in.)	4	5	6	8	10	12	16	20	24	32	40	48
O. D. Tube Size	¼	5/16	3/8	½	5/8	¾	1	1¼	1½	2	2½	3
Hose I. D.	3/16	¼	5/16	13/32	½	5/8	⅞	1⅛	1⅜	1 13/16	2⅜	3
Hose O. D.	33/64	37/64	43/64	49/64	59/64	1 5/64	1 15/64	1½	1¾	2 7/32	2⅞	3 19/32
Working psi.	3000	3000	2000	2000	1750	1500	800	600	500	350	250	200
Min. burst psi.	12000	10000	9000	8000	7000	6000	3200	2500	2000	1400	1000	800
1503-1502 Hose Min. bend radii	1 5/16	2 3/16	2⅝	4⅜	5½	6½	7⅜	9	10½	13¼		
2561-2652 Hose Min. bend radii	3	3⅜	4	4⅜	5½	6½	7⅜	9	10½	13¼	24	33

*Specify Aeroquip Teflon Hose For Chemical And High Temperature Applications

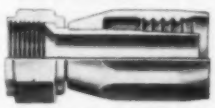
ALL DIMENSIONS IN INCHES

END FITTINGS AVAILABLE

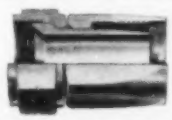
Male Pipe—¼" to 3"



J. I. C. Swivel—¼" to 3"



S. A. E. Swivel—¼" to ¾"



P. T. T. Swivel—1" to 2"

Special Elbow Fittings Are Also Available

Aeroquip 1503, 1502 and 2651, 2652 Single Wire Braid Hose and Reusable Fittings offer many advantages in the design of medium pressure fluid line systems. Recommended for hydraulic, lube and fuel oil, water and air lines, Aeroquip Flexible Hose Lines are superior in installations subject to vibration, stress or flexing. Because of their flexibility, Aeroquip Hose Lines are easy to install in confined spaces, with fewer elbows or adapters than are required with rigid piping or tubing.

REUSABLE HOSE FITTINGS

All Aeroquip Fittings are detachable and reusable. Fittings and hose can be assembled and disassembled quickly. With a supply of bulk hose and reusable fittings, hose assemblies can be made quickly and in quantity in the manufacturer's plant—without need for expensive swaging machines. Another advantage is that hose assemblies on engineering mock-ups can be modified and installed in seconds, using standard bench tools.

The equipment purchaser also benefits because Aeroquip Hose Lines can be replaced quickly and inexpensively right in the field, and the fittings used again and again.

SPECIFY AEROQUIP FOR QUALITY

Aeroquip quality standards are the highest in the industry. From raw materials to workmanship to final inspection, precise, accurate quality control is maintained, resulting in Aeroquip Products that give dependable performance under the most severe operating conditions.

Aeroquip produces a complete line of more than 55 different types of flexible hose—all with matching, reusable fittings—for almost every fluid-carrying application.

Full information is available. Aeroquip Industrial Catalog No. 201 gives complete information on hose, fittings and couplings for industrial applications, plus valuable reference that will help you solve many fluid line design problems. Or write for handy 16-page guide that tells how to plan and install flexible plumbing. Fill in the coupon today.

Complete engineering assistance is available to manufacturers.

Aeroquip Corporation
Jackson, Michigan

☐ Please send Industrial Catalog No. 201.

☐ Please send "Guide for Routing and Installation of Aeroquip Flexible Hose Assemblies."

Name_____

Title_____

Company_____

Address_____

City_____ Zone____ State_____

SEE OUR CATALOG PAGES IN SWEET'S PRODUCT DESIGN FILE, SECTION 6d.

Aeroquip

REG. TRADEMARK

AEROQUIP CORPORATION, JACKSON, MICHIGAN

INDUSTRIAL DIVISION, VAN WERT, OHIO • WESTERN DIVISION, BURBANK, CALIFORNIA

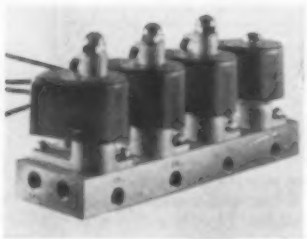
AEROQUIP (CANADA) LTD., TORONTO 10, ONTARIO

LOCAL REPRESENTATIVES IN PRINCIPAL CITIES IN U.S.A. AND ABROAD • AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U.S.A. AND ABROAD

New Products

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

MANIFOLDED VALVES . . . reduce connections



Features: Units are midget-sized 2 and 3-way solenoid valves designed for grouping in numbers on a common body, eliminating separate pipe connections to each valve. Any combination of 2 and 3-way valves may be used when operated from a common pressure and return line. Valve solenoids may be controlled individually or in any combination to meet service requirements.

Specifications: Valve bodies are of forged brass with crown type seats. Solenoids have stainless steel cores and soft composition discs for tight closure. Each valve can be quickly removed from the manifold without disturbing other valves or pipe connections. Valves will handle air or oil up to 212 F, and pressure from zero to 300 psi.

Automatic Switch Co.
Florham Park, N. J.

Circle 180 on Reader Service Card

ROTARY JOINT . . . is freeze-proof

Designation: Exacto

Application: Units have given unusually long life on rotating cylinders in industrial applications, and should have many uses in the fluid power field wherever a rotary joint must be free from seizing or freezing.

Features: Flexible shaft alignment provides easy installation. Unit has packless and self-lubricating bearing surfaces, with low minimum turning torque. Unique internal pressure relief design allows the sealing members to function independently of the operating load. Simplicity of construction allows for quick repairs.

Specifications: A complete range of sizes is available in 1/2 through 1-1/2-in., both TF and S types.

Phillips Sales Co.
West New York, N. J.

Circle 181 on Reader Service Card

AIR VALVE & CYLINDER . . . is compact unit

Designation: Valve-N-Cylinder

Features: Unit can be used for clamping, locating, or push-off of parts on production operations. It consists of a square-rod air cylinder mounting an electric 3-way valve. Valve is compact, fast acting, and easily connected into electrical sequence circuits. Foot, hand, or limit switches may be used to energize the valve. Valve is easily removed from the cylinder, leaving a standard pipe port exposed in the cylinder. Valve and air cylinder may be used separately, or the unit can be reassembled in a few minutes.

Specifications: Valve current characteristics are 110 or 220 volts, 60 cycles. Non-rotating cylinder rod eliminates slides or guide rods. Unit is available with 1, 1½, and 2-in. bores; 1, 2, 3 and 4-in. strokes.

Beckett--Harcum Co.
Wilmington, Ohio

Circle 182 on Reader Service Card

Continued on page 62

MARVEL Synclinal FILTERS

Answer DESIGNERS' S.O.S.

For Dependable Protection on all Hydraulic and other Low Pressure Systems

Simple, Balanced Design . . . is the answer to the growing preference for MARVEL Synclinal FILTERS. Designers are specifying Marvel Synclinal Filters to assure minimum maintenance and maximum protection. Results show Marvel Synclinal Filters superiority in maintaining the greatest degree of cleanliness of liquids in all hydraulic and low pressure systems with minimum downtime. Furthermore, when filter servicing is necessary, Marvels can be easily disassembled, cleaned and reassembled by any workman in a matter of minutes. Line types operate in any position and may be serviced without disturbing pipe connections.

MEET J. I. C. STANDARDS

Again and again, Marvel Synclinal Filters have demonstrated they meet all requirements of the most exacting users, that today—OVER 750 ORIGINAL EQUIPMENT MANUFACTURERS install Marvel Synclinal Filters as standard equipment!

A SIZE FOR EVERY NEED

Available for sump or line installation in capacities from 5 to 100 G. P. M. Greater capacities may be attained by multiple installation (as described in catalog). Choice of monel mesh sizes range from coarse 30 to fine 200.

WATER FILTERS

Both sump and line type filters have been adapted for use in all water filtering applications. No changes have been made in the basic, balanced synclinal design.

IMMEDIATE DELIVERY!

As in the past, Marvel continues to offer IMMEDIATE DELIVERY.

FILTERS FOR FIRE-RESISTANT HYDRAULIC FLUIDS

Marvels most recent development is a filter for the efficient filtration of all types of fire-resistant hydraulic fluids.

Catalogs containing complete data available on request

MARVEL ENGINEERING COMPANY

7227 N. Hamlin Ave., Chicago 45, Ill. **PHONE: Juniper 8-6023**

Without obligation, please send me complete data on Marvel Synclinal Filters, as indicated: AH-9

- ☐ Catalog #108—For Hydraulic Oils, Coolants, Lubricants.
- ☐ Catalog #200—For Fire-resistant Hydraulic Fluids (Aqueous Base)
- ☐ Catalog #400—For Fire-resistant Hydraulic Fluids (Synthetic)
- ☐ Catalog #301—For Water

Name ..... Title .....

Company .....

Address .....

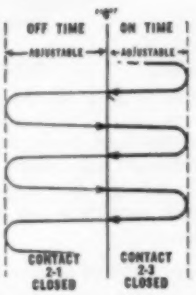
City ..... State .....

EAGLE FLEXOPULSE repeat cycle timer

WITH S.P.D.T. SWITCH

No gear change or resetting of cams

This Flexopulse Repeat Cycle Timer is ideal for controlling processing machines requiring adjustable timed cycles. The "on" or "off" intervals are easily adjusted. Either can be adjusted without disturbing the setting of the other. Instead of resetting cams or changing gears, simply loosen two knurled nuts. Then set "on" and "off" periods by moving adjustable pointer. Tighten screws, and the job's done.



HAS CYCLE PROGRESS INDICATION:

A movable flag indicator passing over the time scale between adjustable arms, indicates portion of cycle elapsed in either of the s.p.d.t. positions. Switching operation takes place at zero.

Flexopulse is ideal for periodically operating valves to reverse the flow of liquids, for operating signals or for injecting chemicals. 120-second up to 20-hour dials are available. Synchronous motor powered. Send coupon today for free bulletin 320.

FREE BULLETIN, MAIL COUPON

EAGLE SIGNAL CORPORATION
Industrial Timers Division, Dept. AH-957
MOLINE, ILLINOIS

Please send free Bulletin 320 with full data on Flexopulse Repeat Cycle Timer.

NAME AND TITLE

COMPANY

ADDRESS

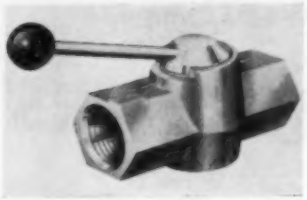
CITY ZONE STATE

New Products / continued

PLUG VALVES

. . . provide tight shut-off

Design: O-ring flow seal provides dead-tight shut-off and O-rings at top and bottom prevent external leakage. In open position the unit is full-ported and allows straight-through flow. These plug valves



are operated by handles that open and close against pressure with absolutely no effort.

Specifications: Available in pipe sizes ¼-in. in brass or stainless steel with aluminum handle, and ½ and ¾-in. in brass. Design eliminates adjusting nuts and springs, assuring long service life.

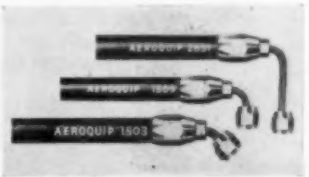
Circle Seal Products Co., Inc.
Pasadena, Calif.

Circle 183 on Reader Service Card

ELBOW FITTINGS

. . . simplify piping

Features: Units simplify hose installation in confined spaces and reduce the number of joints and fittings required. Chief advantages are less flow restrictions, greater space-saving, and reusability of the fittings. By reducing the number of joints in an installation, possible



points of leakage are also eliminated.

Specifications: Fittings are fabricated from formed tubing and are available in swivel nut ends with JIC and SAE threads. Mating adapters are also supplied for straight gasket seal and pipe threads. All parts are steel. Manufactured in 45° and 90° configurations, both short and extended length elbows are available.

Aeroquip Corp.
Jackson, Mich.

Circle 184 on Reader Service Card

Continued on page 64

How **DENISON** hydraulic power works for **LOGEMANN BROTHERS CO.**

Putting more squeeze in presses

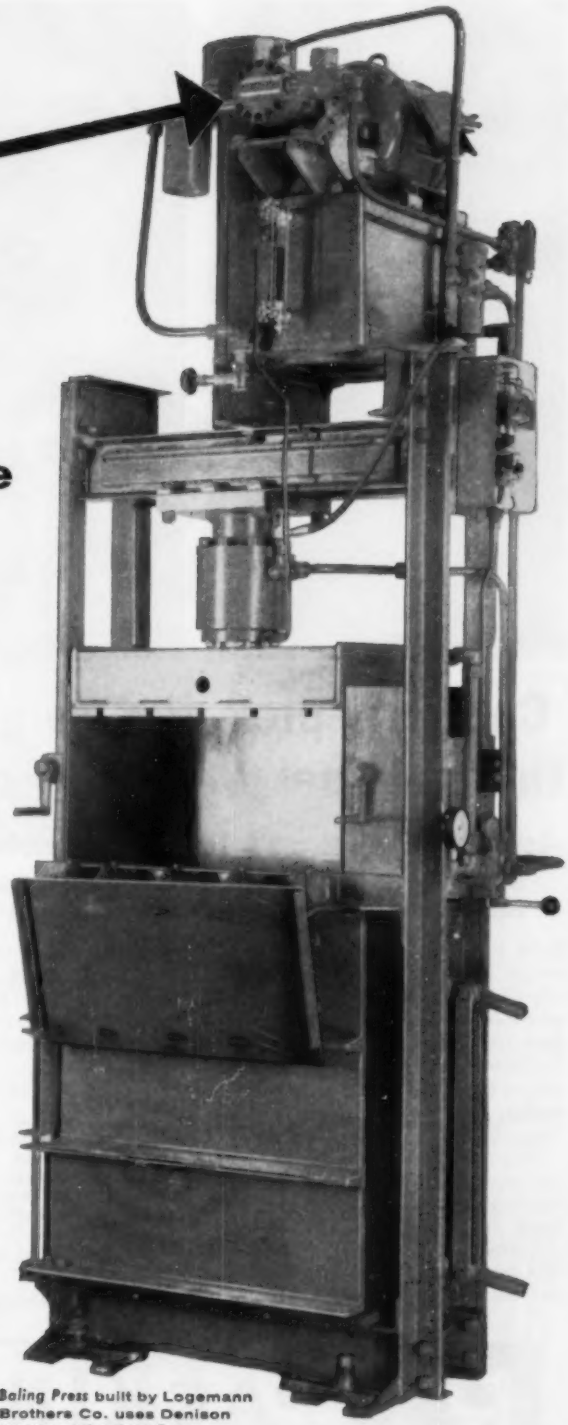
...another application for Denison hydraulic power

Here's how a leading manufacturer of baling presses assures peak performance for his product . . . combines it with dependability for long, continuous service.

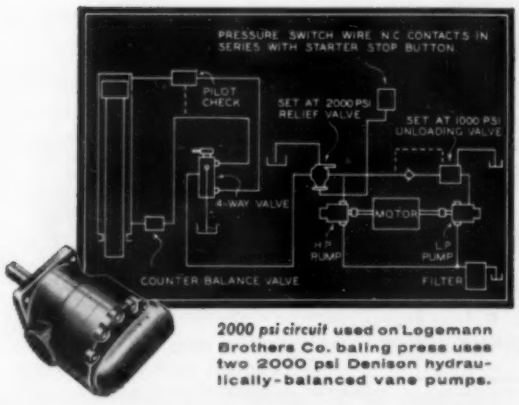
Power and speed of operation are achieved by the use of two 2000 psi Denison TMC balanced-vane hydraulic pumps. One Denison pump is set for 1000 psi for fast ram approach. The second pump is set for 2000 psi to provide necessary pressure for the power stroke.

By using identical 2000 psi pumps, maintenance is simplified and pump life greatly increased.

Endless design problems can be solved by using Denison hydraulic equipment on systems up to 5000 psi. Your Denison representative (who is an experienced hydraulic specialist) will gladly show you how. Write us. Denison Engineering Division, American Brake Shoe Co., 1166 Dublin Road, Columbus 16, Ohio.



Baling Press built by Logemann Brothers Co. uses Denison pumps and valves for 2000 psi hydraulic system.

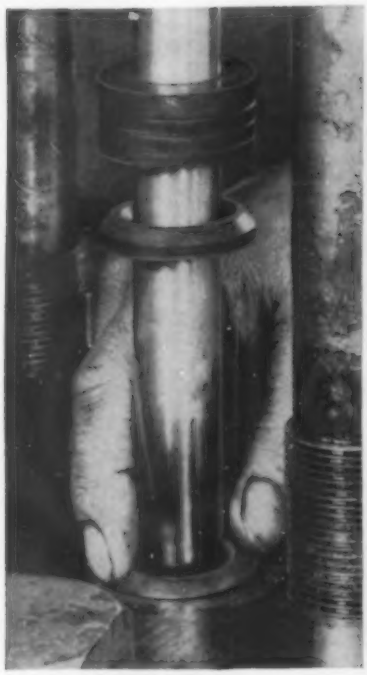


2000 psi circuit used on Logemann Brothers Co. baling press uses two 2000 psi Denison hydraulically-balanced vane pumps.

Denison and Denison HydrOILics are registered trademarks of Denison Eng. Div., ABSCO

DENISON HydrOILics

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS



Can you pick the rings with the original Vee-Flex design?

Appearance won't tell—performance will!

DESIGNED FOR EVERY PISTON AND ROD • ROCK-HARD RINGS • POLYMER SATURATED FABRIC • PRECISION TRIMMING • PROPER INTERFERENCE FOR AUTOMATIC SEALING

R/M Vee-Flex is the original convex-design hydraulic V-ring—self-sealing, self-adjusting. Each ring is convex where it touches the shoulder of the next ring. On the pressure stroke an automatic flexing action occurs, producing a positive seal against shaft and stuffing box wall and against the next ring.

In precision molded R/M Vee-Flex, polymer penetration of the fabric is thorough and deep. This, plus rock-hard adapter rings, enables Vee-Flex to withstand in excess of 6000 psi without extruding. It also stops destructive wicking action.

Specify tough, positive-sealing R/M Vee-Flex Packing for long, trouble-free service on all your piston and rod applications. For complete data, write for the R/M Vee-Flex Bulletin.

R/M makes a complete line of mechanical packings — including Vee-Flex, Vee-Square, Universal Plastic, and "versi-pak"®; Gasket Materials, "Teflon"* Products.

For complete information, send for booklet

*A Du Pont trademark

R/M PACKINGS

RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, PASSAIC, N.J.

MECHANICAL PACKINGS AND GASKET MATERIALS

FACTORIES: Passaic, N.J.; Bridgeport, Conn.; Manheim, Pa.; Neenah, Wis.; No. Charleston, S.C.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks Clutch Facings • Industrial Adhesives • Bowling Balls • Laundry Pads and Covers

New Products / continued

AIR MOTOR

. . . offers reverse rotation

Designation: Model 6AM

Features: Designed for original equipment or plant use in the ½ to 2-hp range. Reversible rotation feature is valuable on applications

such as pneumatic lifts, hoists, materials handling equipment, machine tool positioning, etc. Any 4-way operating valve built for pressure below 100 psi may be inserted in the air supply line for instantly reversible motor control.

Specifications: Motor ports fit ⅜-in. standard pipe. Models with single rotation are also available. All models weigh about 17 lbs, are explosion-proof, and variable in speed from 300 to 2000 rpm on air line pressures from 30 to 90 psi.

Gast Mfg. Corp.
Benton Harbor, Mich.

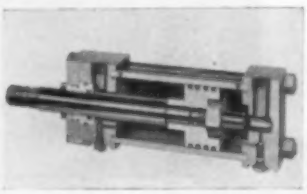
Circle 185 on Reader Service Card

HYDRAULIC CYLINDERS

. . . simplify assembly

Designation: Series N

Specifications: Available in bores from 1½ to 12-in. and rated for operation at 2000 psi and higher,



the cylinders meet JIC specifications. Cylinders are available with a large external thread, a smaller external thread with shoulder, or an internal thread to simplify assem-

Continued on page 66

BUILT BY ENGINEERS WHO SPECIALIZE IN . . .

FLOW REGULATORS

Waterman Engineering Company has furnished thousands of flow regulators to all types of industries with growing satisfaction.

Their experience in this field is most valuable in accumulating a fund of data on flow control applications. Waterman offers you this experience in solving your flow control problems. Only a few of Waterman models are shown on this page.

Write for latest bulletin A

WATERMAN ENGINEERING COMPANY

725 CUSTER AVENUE • EVANSTON, ILLINOIS

Circle 159 on Reader Service Card

Seven-year survey shows experts still prefer **HYDRAMITE** Hydraulic Pumps for rugged applications

A survey of Hydraulic equipment users, made since 1950, reveals that when a constant displacement pump is needed, HYDRAMITE Hydraulic Pumps are still preferred because of their longer service life and greater endurance.

Nine basic features support the superior performance record of AECO HYDRAMITE Pumps:

- Cast-Steel Bodies
- High-Precision Bearings Throughout
- Liberally Sized Components
- Minimized Vibration
- All Parts Lubricated in Full-flooded Case
- Smooth Fluid Flow
- One-way Discharge with Either Rotation
- Quiet Operation Up to 5000 psi
- No Supercharging Needed

So, when the pressure's on your hydraulic operations, be sure you're equipped with AECO HYDRAMITE.

American Engineering Company

Dept. P-141 Wheatsheaf Lane & Sepviva St., Philadelphia 37, Pa.

Canadian Subsidiaries: Affiliated Engineering Corporations Ltd., Montreal, P. Q. - Bawden Industries Ltd., Toronto, Ont.

New Products continued

bly. Two wrench flats are provided, but rods with four or six flats are available for assembly in ordinarily inaccessible locations. Two piston designs are available: High-tensile cast iron, precision-machined, polished and fitted with alloy step-cut rings; and, where bypass is not permitted, a flared-lip, heavy-web piston seal with backup washers.

Hydro-Line Mfg. Co.
Rockford, Ill.

Circle 186 on Reader Service Card

HIGH FLOW FILTER

. . . has low pressure drop

Designation: Type PL

Features: For filtration of oil, water, and other liquids, the filter cartridge consists of pleated filter paper, impregnated with a heat stabilizing resin and cured at the stabilizing temperature. This extended

surface-type filter is then formed around a metal center tube, and the end plates and protective shield are attached. For full flow filter applications, it will filter out particles as small as five microns. Continuous recirculation results in finer filtration.

Hilliard Corp.
Elmira, N. Y.

Circle 187 on Reader Service Card

TEFLON BACK-UP RINGS

. . . give better seal

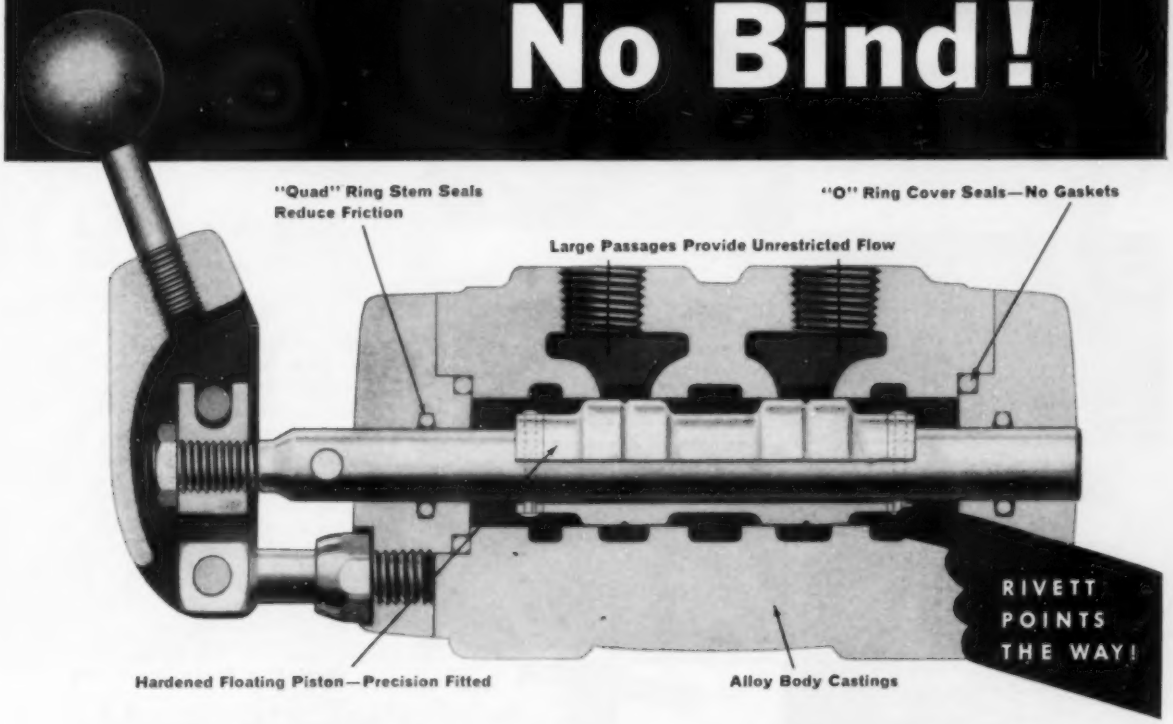
Features: Use of Teflon back-up rings with rubber O-rings gives a better seal, less wear on the O-ring, and eliminates deforming of the O-ring by extrusion under pressure with resulting malfunction. Teflon has been very satisfactory in this service because of its properties of chemical inertness, corrosion and heat resistance, toughness, flexibility and low coefficient of friction.

Sparta Mfg. Co.
Dover, Ohio

Circle 188 on Reader Service Card

Continued on page 68

No Stick! No Bind!


"Quad" Ring Stem Seals Reduce Friction
"O" Ring Cover Seals—No Gaskets
Large Passages Provide Unrestricted Flow
RIVETT POINTS THE WAY!
Hardened Floating Piston—Precision Fitted
Alloy Body Castings

—with Floating Piston!

Valve Stem is Independent of Valve Bore in Rivett Hydraulic Pipe Mounted Valves

Other Fine Features Benefiting Your Circuit Design and Operation

- "Quad" Ring Stem Seals Reduce Friction
- Large Passages Provide Smooth, Full Capacity Flow
- Simple Design Assures Leakproof Operation
- Opens And Closes Smoothly, Positively
- Operates Multi-Million Cycles At 1500 P. S. I.

1607 VALVE SELECTIONS!

Types: Hand, foot, cam, solenoid, pilot, oil pressure, air pressure, flow control, check, deceleration, relief, unloading, sequence, counterbalance.

Sizes: ¼", ⅜", ½", ¾", 1", 1¼", 1½".

Actions: Standard, spring-return, spring-centered, ball detent.

Mountings: Pipe mounted; panel mounted.

P.S.I.: 1500 P.S.I.; 3000 P.S.I. oil service.

Piston designs for any circuit.

RIVETT, INCORPORATED • Dept. AH-9
Brighton 35, Boston, Mass.

THE BETTER YOU KNOW HYDRAULICS THE BETTER YOU LIKE

Get Catalog No. 204 to aid your circuit design. Complete drawings, specifications, cut-away views, tables, diagrams!

RIVETT
"100"
HYDRAULIC VALVES

Member National Fluid Power Association

Circle 127 on Reader Service Card

Ledeen VALVES for longer life

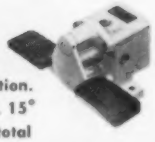
Ledeen Valves are built to operate single or double acting pneumatic and hydraulic cylinders, and motors. These valves embody the rotating disc construction to give the longest possible life. They are built in sizes from ¼" to 1¼" standard pipe connections. Available from stock for quick delivery.

Model HMN
Hand operated to Forward and Reverse. Manual Return to Neutral. 30° throw each way. 60° total throw. Rated at 250 psi.

Model HSN
Hand operated to Forward and Reverse. Spring Return to Neutral. 30° throw each way. 60° total throw. Rated at 100 psi.

Model HSR
Hand operated to Forward. Spring Return to Reverse. No stop in Neutral position. 60° total throw. Rated at 100 psi.

Model FFN
Foot operated to Forward and Reverse by depressing proper pedal to extreme position. Foot Return to Neutral. 15° throw each way. 30° total throw. Rated at 250 psi.

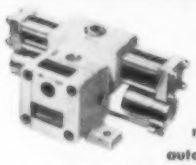


Model FSN
Foot operated to Forward and Reverse by depressing proper pedal to extreme position. Spring Return to Neutral. 15° throw each way. 30° total throw. Rated at 100 psi.

Model FSR
Foot operated to Forward. Spring Return to Reverse. No stop in Neutral position. 30° total throw. Rated at 100 psi.

Model POR
Power operated to Forward or Reverse. No Neutral position. Total throw 60°. Rated at 250 psi.

Model PON
Power operated to Neutral, Forward and Reverse. Total throw 60°. Rated at 250 psi.



Model POR
SOLENOID OPERATED 2-position, Power Valve for remote control or automatic operation. Momentary or continuous energizing.

Model PON
SOLENOID OPERATED 3-position Power Valve for remote control or automatic operation. Momentary or continuous energizing.

Time Delay Valve
Pneumatic Time Delay Valve. Adjustable from 2 seconds to 2 minutes. Available in POR and PON Models.

Pilot Valves

3-way Finger, Cam, Air and Solenoid operated models available in Normally Open and Normally Closed types.

Write for Bulletin 1010

Ledeen Mfg. Co.
3332 North Gilman Road
El Monte, California

VALVES • CYLINDERS • VALVE ACTUATORS
AIR-HYDRAULIC PUMPS AND BOOSTERS

New Products continued

AIR-HYDRAULIC CYLINDER
. . . designed for extra strength

Features: External threads on the cylinder barrel, with internal threads on the heads, prevent cylinder breathing under high pressures. Tie-rods and snap-rings have been eliminated through this design. Outside threads on the cylinder allow full use to be made of internal honed tubing surface, providing a longer stroke on a shorter cylinder. Heads are O-ring sealed cast steel. Cylinder barrels are heavy wall, precision honed, seamless steel tubing. Metallic rod packing used in these cylinders has a low coefficient of friction and long life. Adjustable cushion control valve gives operator positive control.

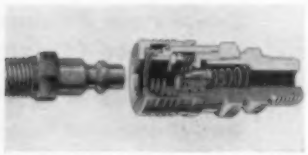
Remco Mfg. Co.
Petaluma, Calif.

Circle 189 on Reader Service Card

QUICK DETACHABLE COUPLER
. . . absorbs vibration

Designation: Fostermatic

Features: Unit provides quick, automatic plug-in and snap-out coupling for pneumatic or hydraulic lines. A floating carrier holds dogs in position and absorbs vibration, eliminating housing wear. Designed for heavy duty service, smaller size and lighter weight, with greater air capacity.



Foster Mfg. Co., Inc.
St. Louis, Mo.

Circle 190 on Reader Service Card

For more NEW PRODUCT reviews turn to page 175

Comparative Tests Prove . . .

Sunvis 900 Oils have years of useful life under severe operating conditions

Versatile, long-lasting Sunvis® 900 oils are especially made to provide superior lubrication at high temperatures and in the presence of moisture. *They keep maintenance costs low.*

Time and again, when checked against new-oil specifications, used Sunvis 900 oils prove themselves fit for many more years of continued service, with *no* loss in performance features.

For example: The 3-year-old sample above was used in an injection molding machine operated for 40-48 hours per week at temperatures between 100 and 125 F. To see how the used oil compares with its original specifications look at the following table.

Specifications	New Sunvis 916	Sunvis 916 After 3 Yr*
API gravity at 60 F	30.5-32.5	30.3
Flash, open cup, deg F, min	400	400
Fire, deg F, min	460	460
Viscosity, SUS at 100 F	150-160	173.0
Viscosity index	90	90
Neut. number	0.10	0.05
Color, ASTM	1-1.5	3.5

*Typical Test

HOW TO GET MORE INFORMATION

Call your Sun representative, or write for Technical Bulletin No. 35, Sun Oil Company, Philadelphia 3, Pa., Dept. I-7.

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY

© SUN OIL CO.

PHILADELPHIA 3, PA.

IN CANADA: SUN OIL COMPANY LIMITED, TORONTO and MONTREAL

SUNOCO®

ACCO
Helicoid Gage
U.S.A.

NOTHING BUT THE BEST IN GAGES FOR WORKING PRESSURES FROM 30" VACUUM TO 10,000 p. s. i.

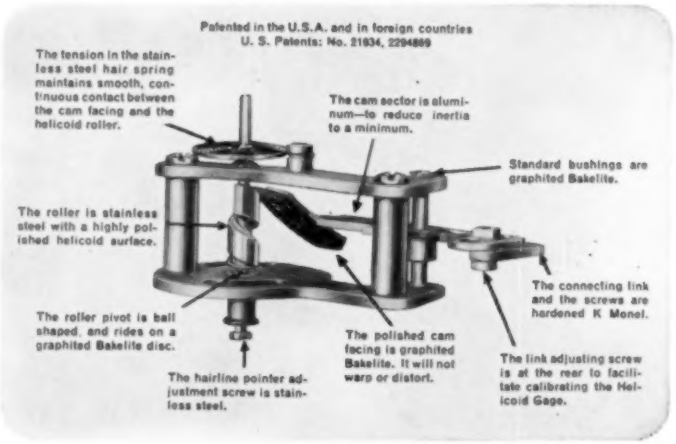
Shock-Proof Cam Actuation (no gears—no teeth) Makes Helicoid Gages Ideal for Hydraulic Services

Designed for pulsating and impact hydraulic service, the Helicoid movement releases at zero in the event of sudden pressure reduction. This eliminates shock on pointer and movement by reducing impact of pointer against pointer stop pin. This protects the gage mechanism where gages may be subject to occasional vacuum.

The superiority of Helicoid Gages is most evident in severe service—wherever a gage is subjected to violent pressure pulsations or certain severe mechanical vibrations.

The *sustained accuracy* of Helicoid Gages over *millions of cycles* is explained by the details of design and construction of the Helicoid movement shown at the right.

Rolling action of the cam facing against the roller surface . . . graphited Bakelite bushings, roller pivot base and cam facing . . . K Monel connecting links and screws . . . all such Helicoid features protect against wear and corrosion and assure sensitivity, sustained accuracy and trouble-free operation through millions of cycles.


Patented in the U.S.A. and in foreign countries
U. S. Patents: No. 21934, 2294899
The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is aluminum—to reduce inertia to a minimum.
Standard bushings are graphited Bakelite.
The roller is stainless steel with a highly polished helicoid surface.
The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

HELICOID GAGE CARTRIDGE SNUBBER

(Patent pending)

This is a simple, effective throttling device to reduce or eliminate pulsations of the gage pointer. There are no moving parts, no adjustments needed. Available in three types in powdered bronze or stainless steel for air, gas, water, steam, medium or heavy liquids.

Enlarged cutaway view

Threaded cartridge body for assembly in any Helicoid Gage tapped socket shank

EASIEST ADJUSTMENT AND CALIBRATION

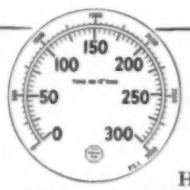
Only Helicoid Gages have the external pointer adjustment pictured here. The Helicoid type adjustment cannot be jarred out of position.

Calibration of Helicoid Gages is accomplished easily, without removing dial or pointer, because the link adjusting screw is at the rear of the system.

TUBES BUILT FOR MILLIONS OF PRESSURE PULSATIONS

To fit the wide range of applications, Helicoid Bourdon tubes are available in four materials—alloy steel, K Monel, stainless steel and phosphor bronze.

All Helicoid tubes are made from seamless tubing and are carefully designed to give maximum torque and minimum stress. When used within the dial range, they will withstand many millions of pressure pulsations and will not stretch, leak nor crack.



DOUBLE SCALE DIAL SHOWS TONS ON RAM AND PSI

Helicoid Gage dials are supplied in jet black with white figure markings or in dull white with black figure markings. They are constructed of laminated phenol with a transparent plastic surface and the longest possible scale length for more accurate readings. They are non-corroding, will not discolor nor fade and will not crack, chip nor peel.

Helicoid Gage Division
AMERICAN CHAIN & CABLE

929-H Connecticut Avenue • Bridgeport 2, Connecticut

ACCO

TRADE MARK

Helicoid gives you all these features at prices that are competitive in the quality gage field

SERVING MODERN INDUSTRY

'VSG'

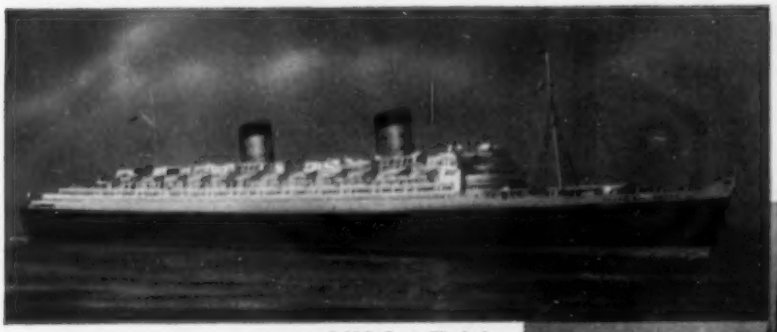
Reg'd Trade Mark

Infinitely

VARIABLE

HYDRAULIC

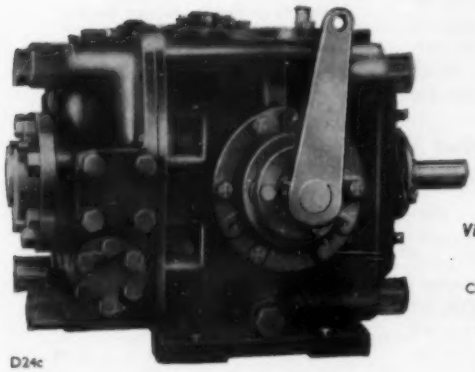
DELIVERY PUMPS



R.M.S. Queen Elizabeth

"DENNY-BROWN" STABILISERS

Yet another example of the highly varied operations to which 'VSG' hydraulic pumps are applied is provided by the Denny-Brown stabilisers fitted to many vessels, including R.M.S. Queen Elizabeth. The 'VSG' pumps are incorporated in the mechanism for actuating each of the four fins.



D24c

One of the two port fins of the Queen Elizabeth Ship Stabiliser

VICKERS-ARMSTRONGS

VICKERS-ARMSTRONGS (ENGINEERS) LTD

Vickers House • Broadway • London • England • Cables: Vickerseng London Telex

Distributed in Canada by **BRANT-CANADIAN DISTRIBUTORS LTD.** through dealers

CONSOLIDATED ENGINEERS & MACHINE CO. LTD.
5645 Pare Street
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BAWDEN INDUSTRIES LTD.
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Toronto 3, Ont.

GALBRAITH & SULLEY LTD.
1331 W. 6th Avenue,
Vancouver 9, B.C.

Main Stocks are carried in Montreal and Vancouver

Useful Literature

For your free copy of publications reviewed, fill in the reader service card

DIAL TIMER . . . for controlling up to six individual load circuits in hydraulic or pneumatic service, is manufactured by Automatic Temperature Control Co., Inc., Philadelphia. Bulletin No. N-140 gives complete engineering and application information, along with illustrations of the unit including installation and maintenance sequence photos.

Circle 240 on Reader Service Card

GASKETS . . . back-up rings, and O-rings, impervious to acids, alkalis, corrosives and solvents, at temperatures from —120 to 500 F, are available from Crane Packing Co., Morton Grove, Ill. Bulletin P-327 illustrates and describes the items and gives a quick-reference standard size and dimension table. Material is fabricated from DuPont Teflon under the name Chemlon.

Circle 241 on Reader Service Card

PRESSURE INDICATORS . . . with quartz crystal transducer elements, are manufactured by Kistler Instrument Co., North Tonawanda, N. Y. Available bulletin gives description and performance characteristics, along with graphic illustrations of typical pressure measurements. Units features one transducer for all pressures, versatility, high accuracy and frequency response, nearly aperiodic damping, high sensitivity, temperature stability and static calibration.

Circle 242 on Reader Service Card

PISTON-TYPE ACCUMULATORS . . . from 1/2 to 10-gal capacity, with 3000-psi maximum operating pressure, are manufactured by Hydramotive, Inc., Cleveland. Models available are covered by individual specifications sheets of their catalog. Gas precharge sheet is also given for each unit, showing oil volumes available at specified operating pressures.

Circle 243 on Reader Service Card

HYDRAULIC CIRCUIT TESTER . . . simultaneously measures temperature, pressure, and flow from any component port in a hydraulic system. Bulletin available from Schroeder Brothers Corp., McKees Rocks, Pa., illustrates and describes the unit, and gives complete specifications. Engineers and maintenance men should find this unit of interest, as it quickly checks operating efficiency of hydraulic circuit components and pinpoints trouble.

Circle 244 on Reader Service Card

AIR CHUCKS . . . cylinders and accessory equipment, produced by The Cushman Chuck Co., Hartford, Conn., are covered in their 75-page Catalog P. O. 65. The first 14 pages are devoted to general information on air-operated chucks, features of air cylinders, and typical installations. Complete information and specifications are given, and the catalog is divided into 7 sections, each being stepcut for quick reference. The parts section shows all parts in exploded illustrations for easy identification.

Circle 245 on Reader Service Card

396 PAGE CATALOG . . . covers on-the-shelf stock of hydraulic equipment, replacement parts, government surplus, and factory closeouts. This edition is available by writing on your business letterhead to Palley Supply Co., Los Angeles.

HOSE FITTINGS . . . for air or hydraulic service are covered in illustrated bulletin available from Service Mfg. & Supply Co., Detroit. Specifications are given on both union and solid type, barbed fittings, hose splicer, branch Y-fittings, brass pipe fittings, hose accessories, and air or oil hose, clamps and ferrules.

Circle 246 on Reader Service Card

TUBE CLIPS . . . pipe straps, or perforated hanger steel for air or oil lines, are described in the catalog of Lowell Engineering Co., Marshall, Mich. These items are designed to eliminate unsightly, makeshift fasteners, and reduce labor and installation costs. Complete specifications are given on sizes 1/8 to 5/8-in., for one to 8 tubes per clip.

Circle 247 on Reader Service Card

CAPS & SEALS . . . of rubber or plastic are manufactured by Shurclose Seal Co., Detroit. Catalog No. 57-4 gives complete specifications for rubber and plastic closures for protection, sealing, or masking of threaded parts, pipe ends or tubing.

Circle 248 on Reader Service Card

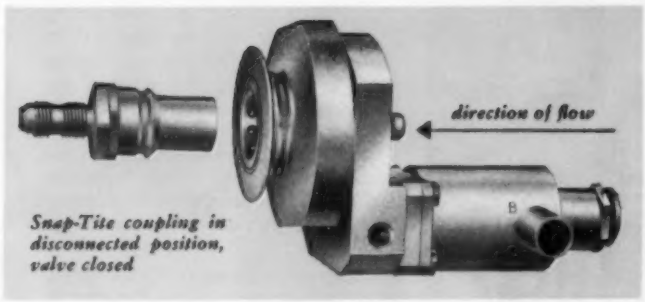
AUTOMATIC COUNTING . . . with pneumatic or hydraulic power, is provided by Pneumaticount, manufactured by Pneumaticount, Portland, Ore. Unit features easy assembly and does not require linkage or solenoids. This device screws into the line controlling an air or hydraulic cylinder, and registers up to 300 counts per minute.

Circle 249 on Reader Service Card

Continued on page 74

Circle 138 →

SNAP-TITE REMOTE CONTROL COUPLINGS FOR GUIDED MISSILES



Snap-Tite coupling in disconnected position, valve closed

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Smooth, streamlined passages assure maximum flow.

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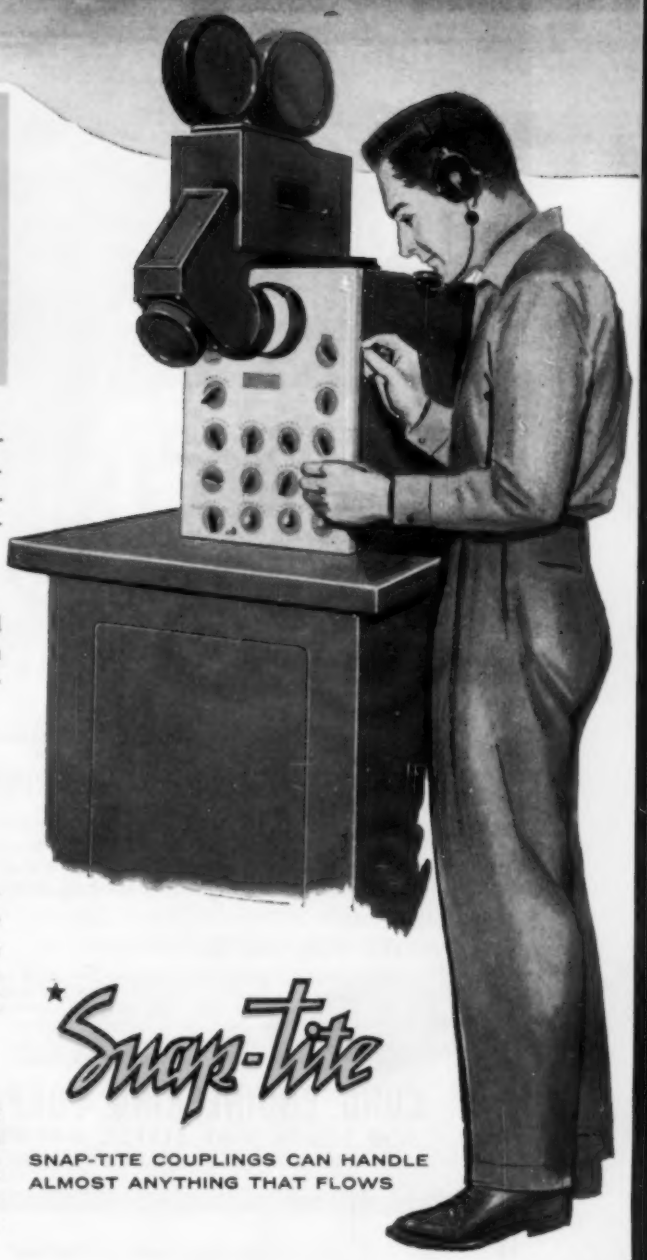

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Circle 250 on Reader Service Card

SMALL OIL CYLINDER . . . single or double-acting, featuring 1, 2, and 3-in. stroke, spring-return, is described in Bulletin No. 756 released by The Sheffer Corp., Cincinnati. This unit should have numerous applications in tooling and automation. It can be fitted into minimum space on machine tools, jigs and fixtures, and can be mounted easily. Bulletin gives engineering information and dimensional drawings.

Circle 251 on Reader Service Card

LIMIT SWITCHES . . . for every type of fluid power service are produced by Micro Switch, Div. of Minneapolis-Honeywell Regulator Co., Freeport, Ill. Units are designed to increase machine speed, efficiency, reduce breakage, waste and injury. Available bulletin illustrates and describes models available, giving design information, specifications, and circuitry variations available.

Circle 252 on Reader Service Card

METAL BELLOWS SEALS . . . designed to operate efficiently above 700 F and below —100 F, are available from Cartriseal Corp., Lincolnwood, Ill. Typical examples of seals are illustrated and described in a bulletin. Units are recommended for use where acids or solvents are encountered. Among applications covered is a special seal for radio-active oil.

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WELDED METALLIC BELLOWS . . . precision engineered to meet latest research developments, are produced by Belfab Corporation,

Continued on page 76

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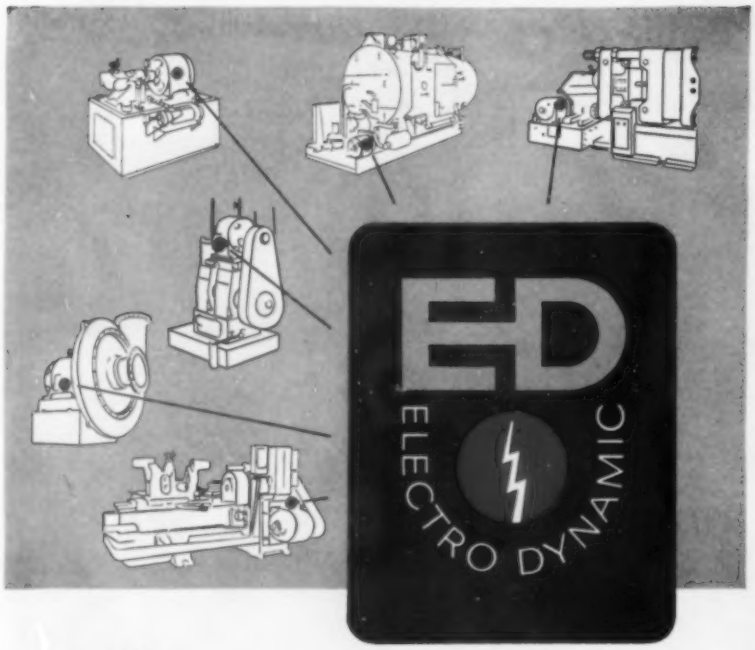

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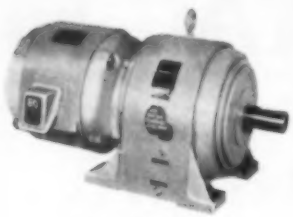

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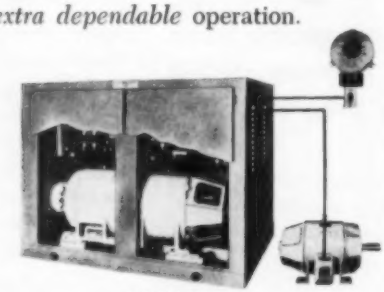

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Useful Literature / continued

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Circle 254 on Reader Service Card

PRESSURE REGULATORS . . . for every type of pneumatic service requirement are described in Bulletin No. 341, issued by Victor Equipment Co., San Francisco. Various models are illustrated for regulating pressures up to 10,000 psi. Charts showing flow rate and pressure drop are given for each model. Units feature a controllable gas pressure applied to the upper surface of the diaphragm instead of a spring force.

Circle 255 on Reader Service Card

FELT FILTER ELEMENTS . . . are described in Bulletin F-101, published by The McIntire Co., Livingston, N. J. Bulletin outlines advantages of felt filter elements rigidly formed into sheets, discs, strips, tubes, round, square and oval domes or cups to specification by a new impregnation and shaping process. Folder gives engineering data, flow charts, recommended uses, and illustrates a wide variety of shapes and typical applications.

Circle 256 on Reader Service Card

AIR & OIL CYLINDERS . . . new line of fork-type rear head units, manufactured by A. K. Allen Co., Brooklyn, is illustrated and described in bulletins AN and BN. Line features fork type rear head, Nylined bearings, and choice of fixed or adjustable cushions for either end, or both. All cylinders are available as double-acting, or single-acting spring return.

Circle 257 on Reader Service Card

For more reviews of FREE LITERATURE turn to page 163

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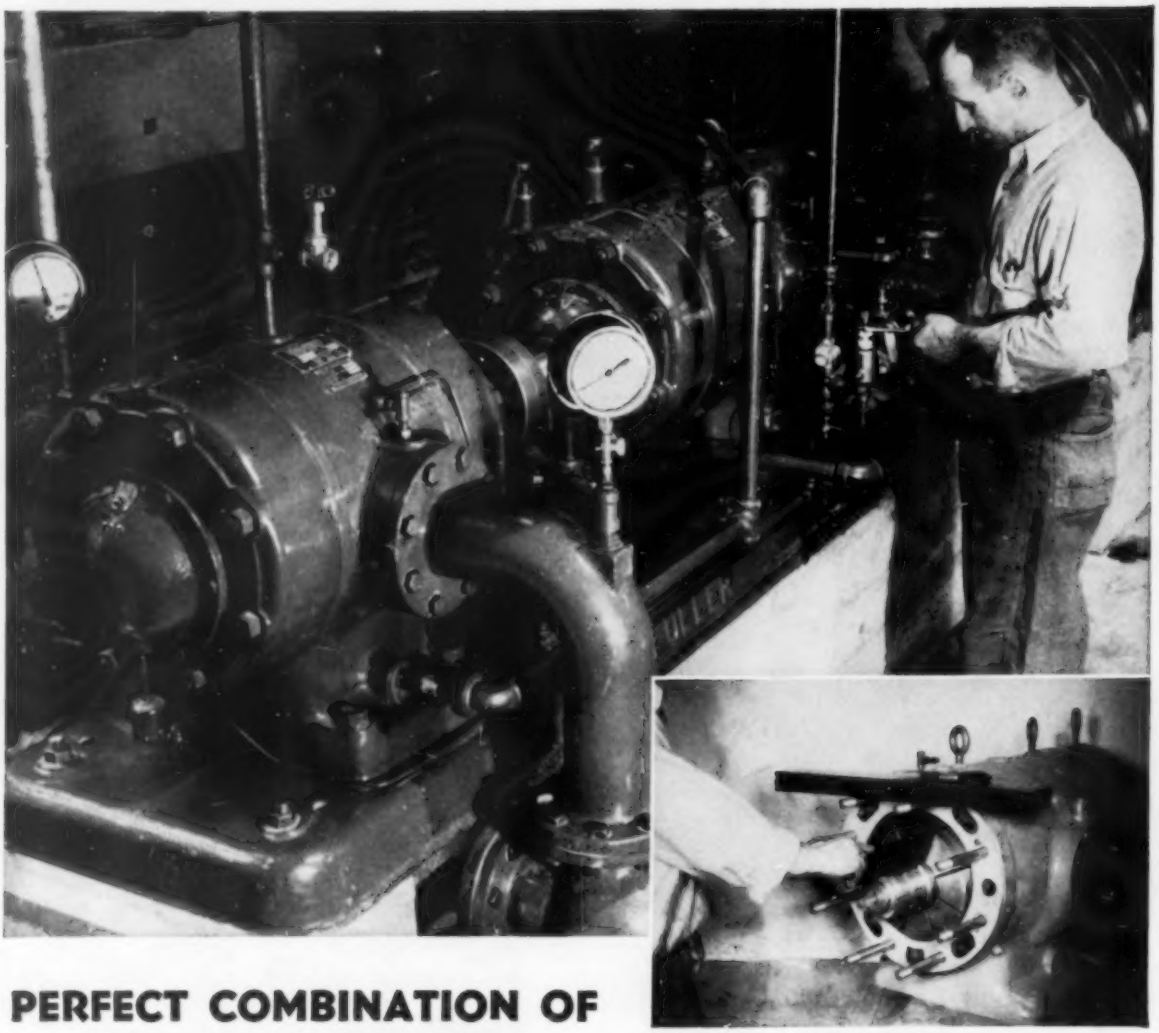

Blade inspection

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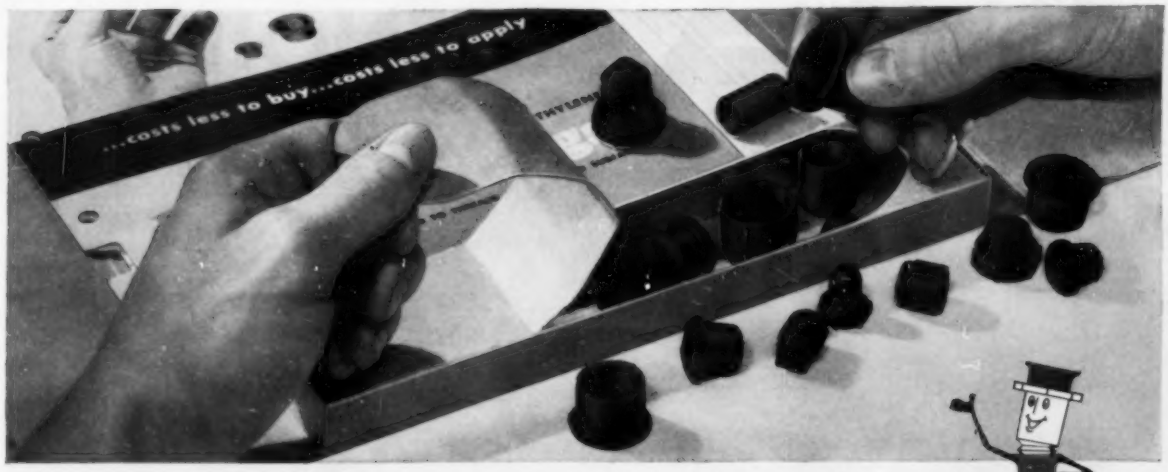

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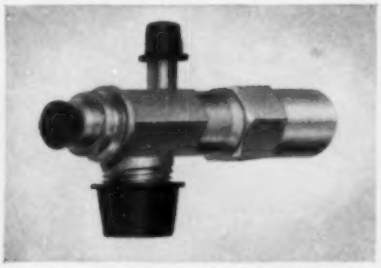

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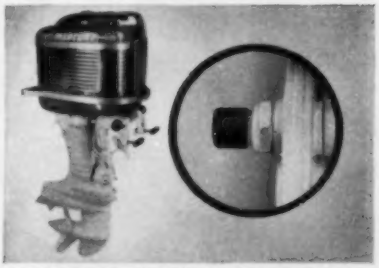

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Colorful CaPlugs spruce up your product and reflect the care you have taken to keep delicate systems free of dirt, moisture or foreign matter. This Bristol air control instrument is a good example. Says The Bristol Company, "They are sturdy enough so that they are not accidentally dislodged, but are still easily removable."

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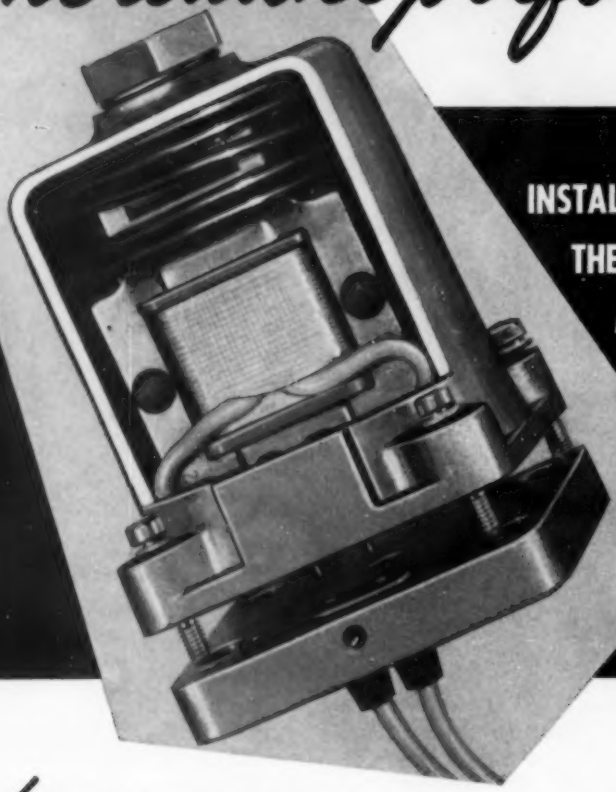

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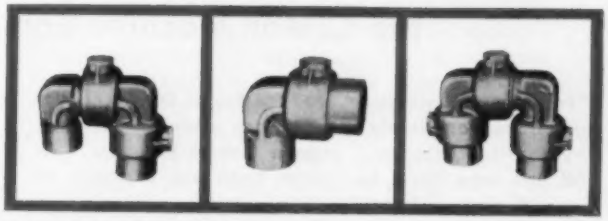

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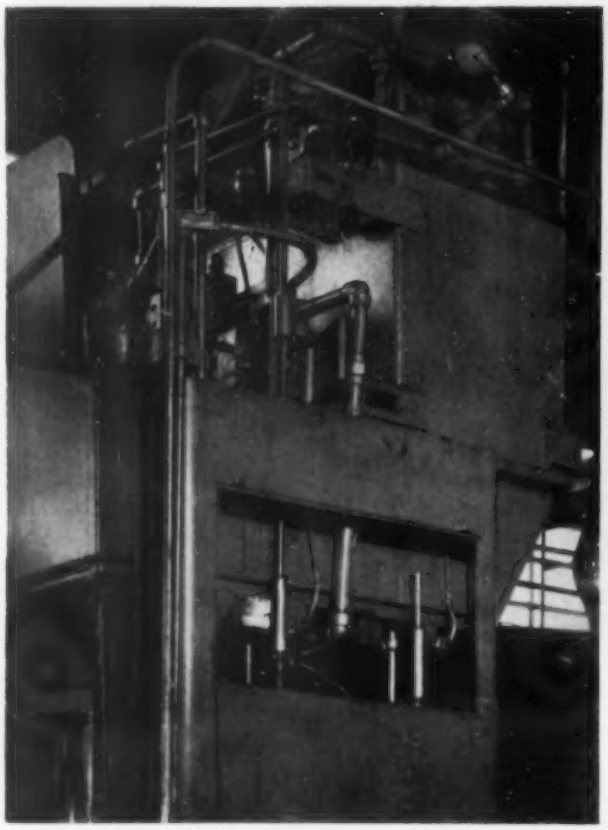

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"We got rid of rust, sludge and foam for good with Texaco Regal Oil R&O"

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"For the past six years, *Texaco Regal Oil R&O* has given us completely trouble-free operation of our hydraulic equipment," reports Robert Bellmore. "In all this time, there has never been any evidence of rust, sludge, or foam."

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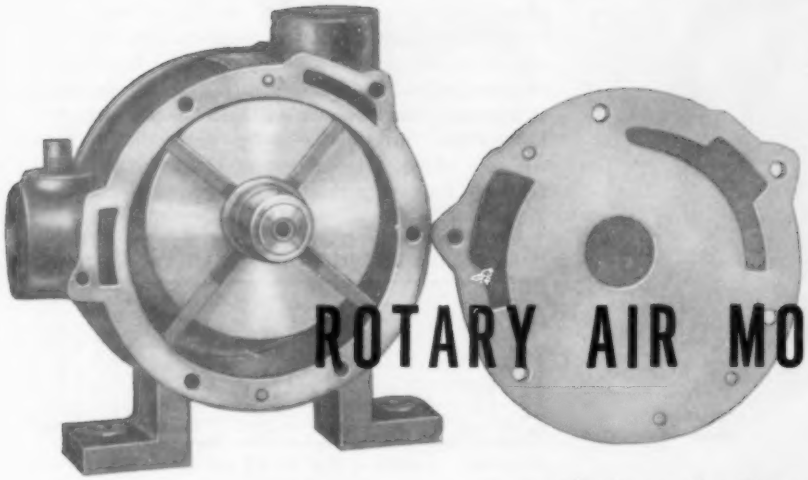


ROTARY AIR MOTORS

. . . their selection and application

● By Keith A. Carlson
Associate Editor

Available in a number of types and sizes, air motors provide solutions to many design problems. Here's a summary of what's available . . . performance characteristics, size, weight, mounting arrangements, construction and possible applications.

AIR motors offer many of the advantages of any fluid motor. They may be stalled for extended periods of time without damage. They are safe for use in hazardous locations, since there is no danger of fire or explosion due to the nature of the motor or fluid leakage. Many of them are easily reversible by simply reversing inlet and outlet connections with a valve. Speed is easily varied by throttling inlet air.

TYPES

There are five distinct types of rotary motors based upon construction: (1) vane, (2) Roots, (3) axial piston, (4) radial piston and (5) turbine. The first four of these five types are often called positive displacement motors since their speed is theoretically directly proportional to the volume of flow through them. Performance characteristics of the positive-displacement motors are qualitatively the same.

ROTARY AIR MOTORS

• ***Vane Motors***—Typical vane motors, Figure 1, consist of a rotor with four sliding vanes located eccentrically in a cylindrical housing. Compressed air admitted through the inlet port fills the cavity between vanes, housing and rotor. Due to the unequal areas of the vanes, a force unbalance exists which causes the motor to rotate in the direction of the vane with the largest area extending from the rotor. Most important characteristics of available vane motors are listed in Table 1.

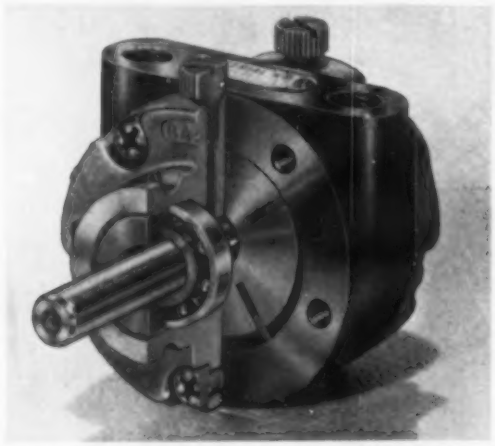


FIG. 1. Vanes, sliding in slots in a rotor which revolves in an eccentric housing, contact the periphery of the housing as well as the end plates to effect a seal. Vanes may be of graphite or other material requiring no lubrication.

TABLE 1—TYPICAL
VANE MOTOR CHARACTERISTICS

Operating Pressure (psi)	Power, Max. (hp)	Speed at Max. hp (rpm)	Weight (lb)	Reversable	Size, Length, Width, Height (in.)	Air Consumption at Max. hp (cfm)	Specific Air Cons. (cfm/hp)
80	.30	6000	1.5	No	4 1/4 x 2 7/16 x 2 1/2	10.8	36.4
80	.94	1800	8	Yes	7 1/8 x 3 1/2 x 5	35	37.2
90	1.12	2000	8	Yes	5 13/16 x 3 3/4 x 5 11/16	32	29
80	3.0	1500	25	Yes	8 7/16 x 5 1/2 x 6 7/16	87.5	29.17
80	4.5	800	45	No	10 1/8 x 7 x 9 1/16	236	52.5
90	10.0	3100	—	Yes	11 23/32 x 11 x 11 9/16	—	—

• ***Roots Motors***—A variation of the familiar Roots blower, Roots-type air motors consist of two, lobed impellers which revolve in circular bores in a housing, Figure 2. Impeller shafts are supported at each end by bearings and are geared together to insure that they rotate with the correct relationship to each other. Design is such that the impellers do not contact each other or the housing. Although no actual contact is made, clearances are, of course, small to limit leakage. Because of this construction, no lubrication of the Roots motor is required except for the bearings which may be of the grease-packed and sealed type.

As air is admitted to the Roots motor, it fills the space between the lobes, housing bores and end plates. Pressure acting upon the lobes tends to force them apart producing rotation. Gearing is such that they must rotate in opposite directions of their forces would cancel each other. Lobe design is such that pressure on the lobes produces a force whose direction is always perpendicular to the face of the lobe. Pertinent characteristics of available Roots motors are summarized in Table 2.

TABLE 2—
ROOTS MOTOR CHARACTERISTICS

Operating Pressure (psi)	Power, Max. (hp)	Speed at Max. hp (rpm)	Reversable	Size-Length, Width, Height (in.)	Air Consumption at Max. hp (cfm)	Specific Air Consumption (cfm/hp)
60	46	10,000	Yes	12 1/2 x 5 1/2 x 6 1/2	1725	37.4
60	13.4	10,500	Yes	8 1/2 x 4 3/4 x 5 1/2	456	34.1
50	4.2	10,500	Yes	4 1/2 x 3 1/2 x 4 1/2	193	46

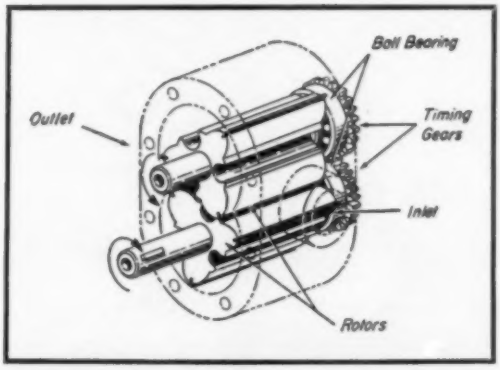


FIG. 2. Only the bearings of this Roots Air Motor require lubrication. They may be of the prepacked, sealed type.

• ***Axial Piston Motors***—Axial piston air motors, Figure 3, consist of four or five pistons in bores in a housing. Direction of motion of the pistons is parallel to the axis of rotation of the output shaft. Ends of the piston rods opposite the piston bear against a swash plate to convert linear motion of

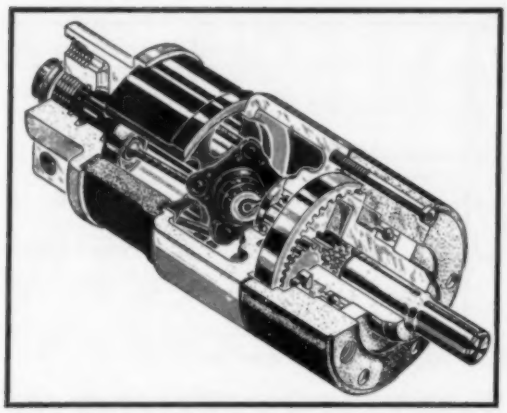


FIG. 3. Typical axial-piston air motor has a planetary gear reducer as an integral part of the assembly.

TABLE 3—TYPICAL AXIAL PISTON MOTOR CHARACTERISTICS

Operating Pressure (psi)	Power, Max. (hp)	Speed at Max. hp (rpm)	Weight (lb)	Reversable	Size-Length, Width, Height (in.)	Air Consumption at Max. hp (cfm)	Specific Air Consumption (cfm/hp)
90	0.6	2360	14	Yes	11 15/16 x 4 1/8 x 4 1/8	21	35
90	0.9	2150	14.5	Yes	13 3/16 x 4 1/8 x 4 1/8	40	44.5
90	1.9	1820	26.5	Yes	16 x 6 x 6	62	32.6
90	2.7	1300	38	Yes	17 x 6 3/16 x 6 3/16	83	30.7

the piston into rotary motion. Air is admitted to the bores to force the pistons to move and produce motion. Table 3 lists ratings, weights, size, etc. of commonly available axial piston motors.

• ***Radial Piston and Vee Motors***—Except for the physical arrangement of the cylinders and pistons, Figure 4, performance and method of operation of these types of air motors are similar to those of the axial piston type. However, operating speeds tend to be lower. This is because these are generally larger motors, and friction is, therefore, higher. Characteristics of these motors are summarized in Table 4.

TABLE 4—RADIAL AND VEE-TYPE AIR MOTOR CHARACTERISTICS

Operating Pressure (psi)	Power, Max. (hp)	Speed at Max. hp (rpm)	Weight (lb)	Reversable	Size-Length, Width, Height (in.)	Air Consumption at Max. hp (cfm)	Specific Air Consumption (cfm/hp)
Radial							
90	.17	1000	7	Yes	———	6	36
90	.75	1500	23	Yes	———	35	46.6
90	1.5	700	90	Yes	———	60	40
100	3.38	1250	43	Yes	12 x 12 x 14	92	27.4
100	6.1	1500	95	Yes	14 x 14 x 20	177	29
100	13	1000	195	Yes	18 x 18 x 23	350	27
100	16.2	1000	205	Yes	18 x 18 x 23	400	24.8
Vee							
90	.5	400	16	Yes	———	25	50
90	1.0	300	35	Yes	———	40	40
90	1.5	200	48	Yes	———	55	36.6

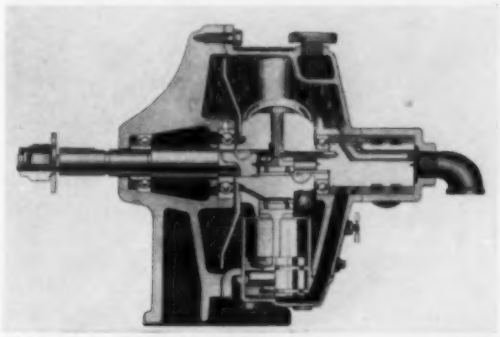


FIG. 4. Typical radial-piston air motor resembles a radial engine. Lubrication is by splash from an integral sump.

POSITIVE-DISPLACEMENT MOTOR PERFORMANCE

Torque output for a given positive-displacement motor is theoretically a function of the differential pressure and a constant determined by the physical parameters of the motor. This means that torque should be constant for a given applied pressure, regardless of speed. This is not the case in practice; because, as air flow through the motor increases, pressure losses in inlet and outlet lines and porting account for a greater portion of the applied pressure. Theoretical and actual torque curves are shown in Figure 5.

Speed of these motors should be directly proportional to flow rate since the motor is a constant-displacement device. This would be true were it not for leakage. Actually, leakage rates do affect speed. Leakage rates are higher at higher pressures. So at a fixed speed, air consumption increases as applied pressure increases. Leakage is nearly constant for a given pressure. Therefore, at low speeds a much higher portion of the total flow is lost through leakage. Curve of performance for an actual air motor, Figure 6, shows that the additional increment of flow per rpm is nearly constant although total flow per revolution decreases as speed in-

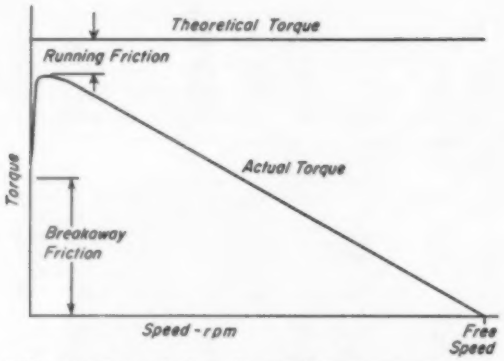


FIG. 5. Theoretical and actual torque—speed relationships for positive-displacement air motors show how starting torque is reduced by breakaway friction and how flow losses reduce torque to zero at the free speed.

creases. Leakage also decreases slightly as speed increases because time available for leakage decreases.

Since horsepower is proportional to speed and torque, horsepower characteristic of positive-displacement motors is as shown in Figure 7. As the curve shows, horsepower increases as speed increases until a point is reached where torque decrease balances the speed increase. Horsepower then decreases until it is zero at the point where torque is zero, because all pressure is being used to force the volume of air required for this speed through the motor and its passages. This particular speed is called the free speed and is approximately twice the speed of the motor at the maximum horsepower point. Many of the performance curves published by motor manufacturers may not include the complete performance curve up to the free speed point because the motor is not mechanically designed to withstand the stresses which occur at such high speeds. In such cases, the manufacturer will usually either equip the motor with an overspeed governor or specify that the motor must not be operated with loads below a certain value.

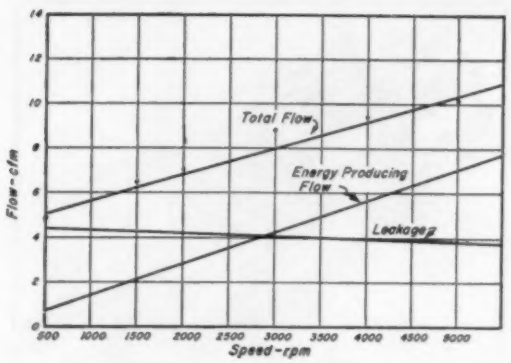


FIG. 6. Since leakage flow is relatively constant, more of the total air flow through a motor is lost at low than at high speeds.

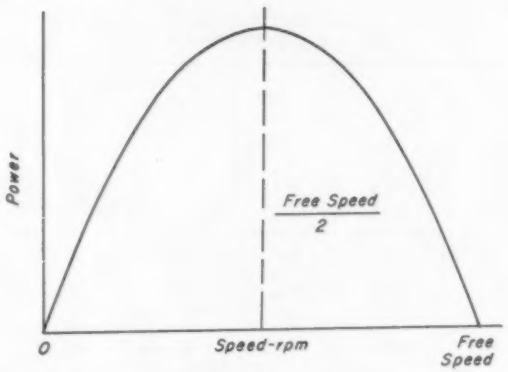


FIG. 7. Speed-horsepower relationship for constant-displacement air motors.

TURBINE MOTORS

General characteristics of air turbine motors are very much like those of the positive displacement types. But operating speeds of the turbines are much higher. Torques are lower. For example, a typical ½-hp turbine develops its maximum power at 50,000 rpm with 100 psi line pressure. Torque corresponding to this is 0.0525 lb-ft. For comparison purposes, a typical vane motor developing ½ hp with 90 psi inlet air develops this maximum horsepower at 2000 rpm with torque in the inverse ratio or 25 times that of the turbine. Of course, reduction gearing may be used to obtain the same output from the turbine. However, this introduces additional components and cost.

Construction of turbines, Figure 8, is simple. The only moving parts are turbine wheel, shaft and bearings. There is no actual contact of moving parts with the exception of the bearings. In the turbine shown, shaft seals are not even necessary since the

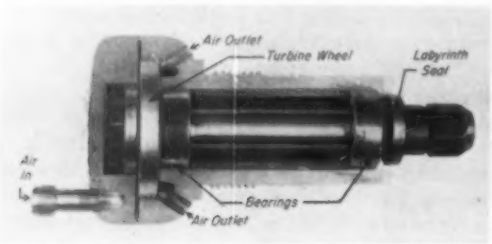


FIG. 8. Cutaway view of a typical impulse turbine air motor shows simplicity of construction.

upstream side of the turbine wheel is entirely contained within the housing.

Efficiency of air turbines can be very good. Better, in fact than that of the positive-displacement types of air motors. However, turbine efficiency is not as constant as that of the other types of air motors. Therefore, for operation over a wide range of speeds, positive displacement air motors will probably show higher overall efficiency.

Acceleration and decleration of turbines is somewhat sluggish when compared to other types of air motors. Turbines are best suited to applications requiring high and nearly constant speeds. Table 5 lists characteristics of industrial air turbines.

TABLE 5—CHARACTERISTICS OF SOME TYPICAL TURBINE MOTORS

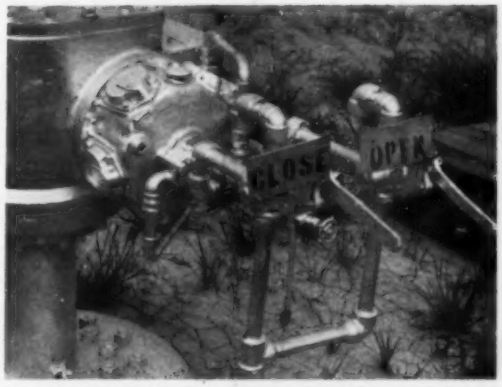
Operating Pressure (psi)	Power, Max. (hp)	Speed at Max. hp (rpm)	Weight (lb)	Reversable	Size-Length, Width, Height (in.)	Air Consumption Average (cfm)
100	.25	50,000	3.13	No	6 3/4 x 3 3/16 x 3 3/16	8
100	.75	30,000	12	No	10 9/32 x 4 1/4 x 4 1/4	16
100	2.0	22,000	30	No	10 17/64 x 5 3/4 x 5 3/4	20

SELECTION AND APPLICATION

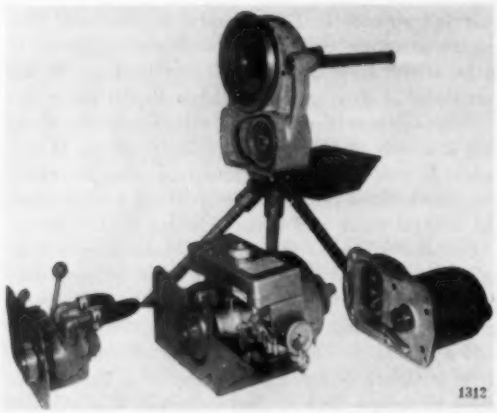
Certain applications are naturals for air motors. These include: 1) locations where air or other gas under pressure is more readily available than electricity or other forms of energy, (2) dirty, dusty and wet locations, (3) hot locations, (4) locations where the presence of electrical power would constitute a definite safety hazard, and (5) jobs where their relatively low weight is a real advantage.

Air motors are immune to dust, dirt and moisture because the air under pressure in the motor does a good job of excluding this wrecking crew. Of course, air supplied to the motor must be clean. It has been claimed that air motors may operate under water because of this particular characteristic. Pressure would have to be supplied to the motor at all times, of course. Hot locations are a breeze for air motors because the constant flow of

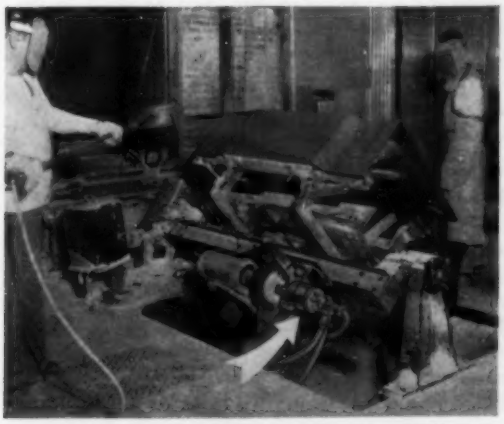
Continued on page 134



Radial-piston air motor for opening and closing a large valve in a natural gas pipe line. Two reasons dictated the use of an air motor in this application. First was safety. Second, gas under pressure from the pipeline is a convenient operating medium.



From left to right at the bottom of the photo, air, gasoline, and electric power units for a portable pipe threading machine are shown. Air powered version of the threader is intended for use at locations where air is the only convenient power source.

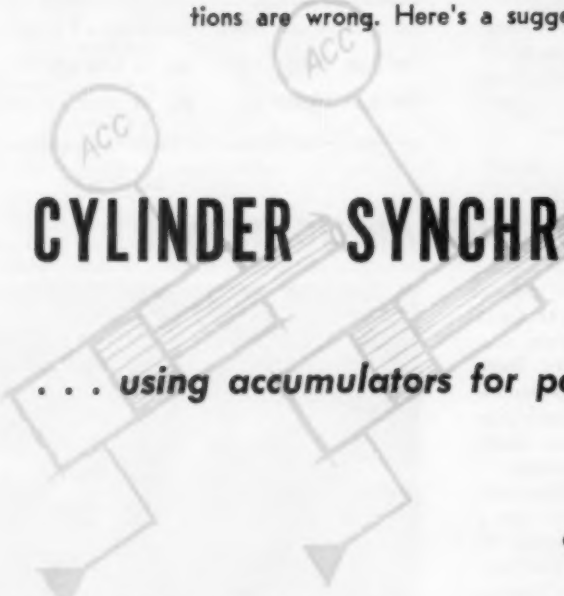


An axial-piston air motor operates a turn table for rotating red hot bathtubs for enameling. Speed and direction of rotation are easily controlled by a foot-operated four-way valve. Operation of the motor is unaffected by the intense heat present.

Synchronizing motion of two or more hydraulic cylinders is a continually recurring problem in hydraulic circuit design. There are many solutions to the problem. Some are good. Some not so good. The only really accurate methods incorporate position measuring devices, feedback and a means for taking corrective action when cylinder positions are wrong. Here's a suggested all-hydraulic method of . . .

CYLINDER SYNCHRONIZATION

. . . *using accumulators for position detection*



• By Robert E. Raymond

THERE are many methods of position detection and feedback that may be used for accurate synchronization of hydraulic cylinders. Racks, gears or other mechanical means to obtain differential input to a servo valve may be used. There are also electro-hydraulic means to do the same thing. A possible pure hydraulic method of position feedback is shown in Figure 1. In this circuit, hydropneumatic accumulators are used as position detectors. Since the fluid forced from the cylinders as they move results in an increase in pressure exerted by the accumulator proportional to the displaced fluid, the accumulators become displacement to pressure transducers.

• **Synchronizing Circuit**—In the circuit shown, Figure 1, directional valves and certain other circuit components have been eliminated to simplify an understanding of the basic synchronizing circuit. It is assumed that the cylinders in this circuit are identical; that they have 100% volumetric efficiency; that control orifices are identical, and that the accumulators are identical. These are safe assumptions since, in a practical circuit, the discrepancies would be negligible as far as their effect upon system response is concerned.

Speed of both cylinders is controlled by the pressure-compensated, flow-control valve in series with cylinder *A*. The control valve is a balanced spool amplifier actuated by pressures *Pa* and *Pb* which are a function of ram position or the amount of oil displaced by the rams, and ram velocity. Pressure P_a tends to force the control valve open and allow more oil to pass to cylinder *B* while pressure P_b tends to close the control valve and stop flow to cylinder *B*.

If the accumulators are equal in size and precharge pressure, cylinder *A* commands cylinder *B* to be at the same position. Higher pressure in accumulator *A* than in accumulator *B* will cause the control valve to direct more oil to cylinder *B* so that it speeds up to reach the same position. If cylinder *B* gets ahead of cylinder *A*, the increased pressure created in accumulator *B* will tend to close the control valve and make cylinder *B* slow down.

Orifices in series with the accumulators act as velocity dampers to control the rate of response. As one of the cylinders is advancing to the correct position its velocity is controlled by retarding pressure of the orifice as well as by the orifice pressure drop feedback difference which acts on the control valve to reduce flow to that cylinder. This velocity feedback prevents oscillation of the system or "hunting." Adjustment of these orifices results in fastest possible response without the undesirable oscillation.

ROBERT E. RAYMOND, *Project Engineer, Simplex Engineering Co., Zanesville, O.*

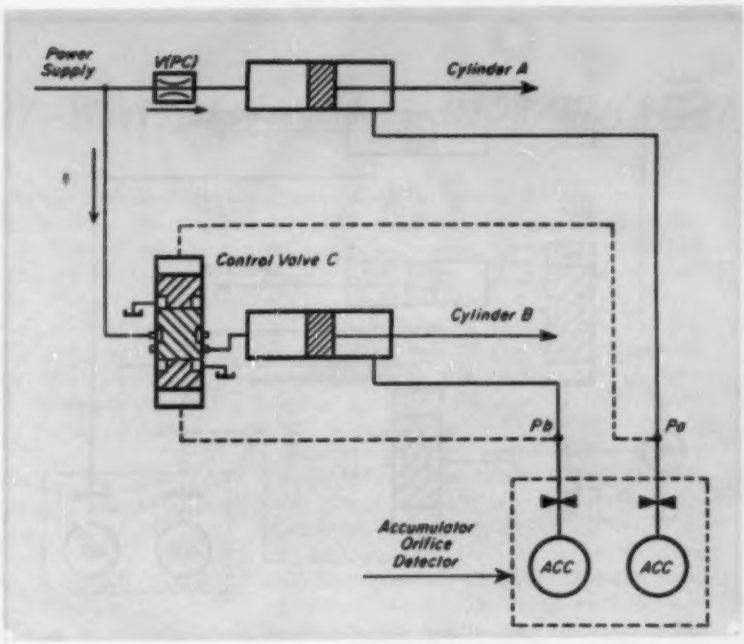


Fig. 1. Circuit for all-hydraulic position control of hydraulic cylinders uses accumulators as position detectors. Fluid displaced from the rod ends of the cylinders during the stroke produces a change in accumulator pressure proportional to piston displacement. Pressure signal is fed to the control valve to maintain synchronism of the cylinders. Rate or velocity feedback to prevent oscillation or "hunting" is provided by the orifices in series with the accumulators.

• **Design Considerations**—Obviously, the power supply for such a system must have capacity in excess of that required for normal ram speeds to permit fast corrective movement. Additional flow capacity equal to approximately 50% of the nominal demand of the slave cylinder should suffice.

Accumulator selection is based on two considerations. First, accumulators used should be of such capacity that pressure rise during the working stroke will be moderate. Second, the slope of the accumulator pressure-volume characteristic should be such as to give maximum sensitivity without becoming extremely nonlinear. Pressure rise during the working stroke may be found from

$$\Delta P = (P_o + P_s)(V/V_o)/(1 - V/V) \quad ..(1)$$

where: ΔP = pressure rise during the working stroke, psig
P_o = accumulator precharge pressure, psig
P_s = atmospheric pressure 14.7 psia
V = total ram discharge, cu in.
V_o = maximum accumulator volume or initial gas volume, cu in.

If V_o is chosen equal to $2V$, the equation reduces to

$$\Delta P = P_o + P_s \quad .....(2)$$

This valve of V_o has been chosen because it produces high but fairly linear sensitivity Figure 2 and also simplifies accumulator selection criteria. Pressure rising during the working stroke is, therefore, equal to accumulator precharge pressure plus atmospheric pressure. From this it follows that total reaction pressurt P_T at the end of the working stroke is

$$P_T = 2P_o + P_s \quad .....(3)$$

Sensitivity of the detector stage may be defined as $\Delta p/\Delta X$. Then the total pressure change required during the cylinder stroke of S in. is

$$\Delta P = \frac{\Delta P}{\Delta X} S \quad .....(4)$$

By equating this with the previously found expression for ΔP, the accumulator precharge pressure

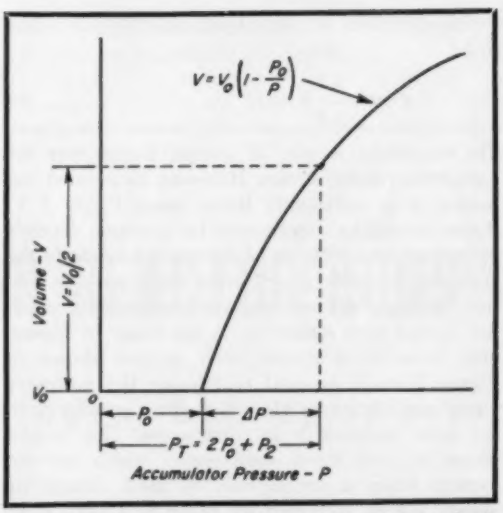


Fig. 2. In designing a circuit to use pressure feedback from accumulators for position control, ratio of pressure change during the working cycle to precharge pressure, or volume change to initial volume, is chosen to give high sensitivity and fairly good linearity. Using $V = V_o/2$, where V = displaced volume of the cylinder, and V_o = initial accumulator gas volume, gives this result.

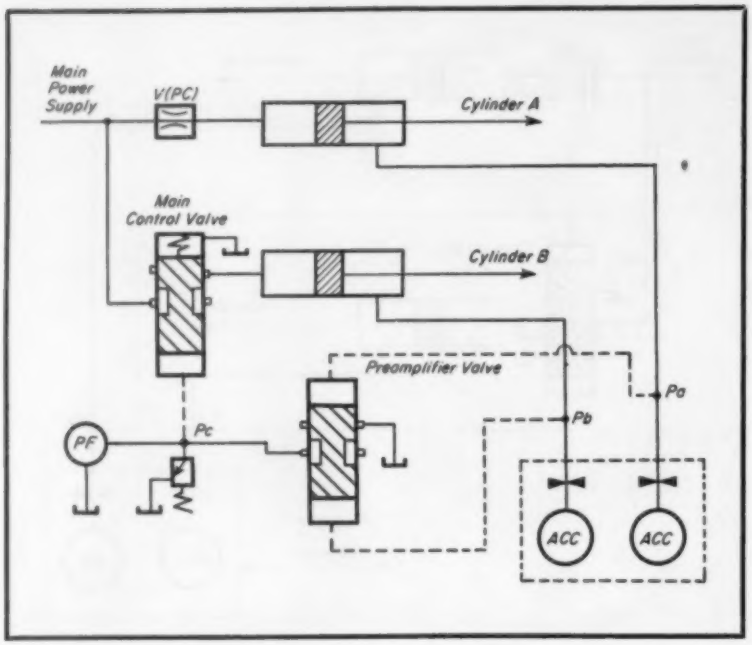


Fig. 3. Sensitivity and accuracy of the accumulator position control can be improved by using an auxiliary low-pressure power supply and a preamplifier valve as shown here. Use of this system would also permit operation to be more nearly linear.

required for this average signal sensitivity is found to be

$$P_o = \frac{\Delta P}{\Delta X} S - P_s \quad \text{.....(5)}$$

The sensitivity is not, of course, linear over the complete cylinder stroke. However, as pointed out before, it is sufficiently linear when $V_o = 2\ V$. Actual sensitivity requirement for a system depends upon the characteristics of the control valve. In the event that control valve characteristics such as friction, leakage or power input requirement could not be met with sensitivity in the range of reasonable linearity, a system such as that shown in Figure 3 could be used to provide the necessary signal amplification. Also, high force sensitivity in the valve requires large pilot areas. This creates phase lag and steady-state errors which are not present when a preamplifier is used. Sensitivity should not be increased by going to a high $V{:}V_o$ ratio. This would increase average sensitivity but would result in drastically nonlinear sensitivity. At low volume, sensitivity would be extremely low, and at high volume, sensitivity would be unduly high.

Insofar as actual layout of this system is concerned, the accumulators and orifices may be located at any distance from the working cylinders without affecting performance since throttling losses in the lines have no effect. However, the accumulators should be close to each other. This provides automatic temperature compensation and gives a high degree of equalization for any adiabatic tendencies.

• **Possible Circuit Modifications:**—In addition to the use of a preamplifier to increase sensitivity, there are certain other conditions which could be most easily met by some modification of the basic circuit. If the working cylinders were quite large, it would be better to use small cylinders driven by the piston rods of the main cylinders for position detection. This would permit the use of much smaller accumulators. High precharge pressures could then be used to increase sensitivity without the power demand which would be made if high precharge pressures were being exerted against the main cylinders. Use of small detector cylinders in this way would also permit simplification of the circuitry when power reversal of cylinder movement is a requirement.

High pressure feedback attained by the use of auxiliary pistons would also permit using diaphragm pistons for pilot control of feedback valving. This would eliminate a leakage problem in the valves. ▼▼▼

Previous articles on accumulator application which have appeared in Applied Hydraulics are:

Design Considerations for Stopping That Bounce
J. J Melead — March, 1955

Accumulator Cutout Circuit Reduces Fire Hazard
J. E. Bullen — October, 1954

Accumulator Circuit Reduces Operating Temperature and Gives Constant Cycle Time
C. B. Blake and A. M. Steel — June, 1954

How to Prevent Hydraulic Shock on Mobile Equipment
L. Drasin and W. Stampfl — October, 1954

Three Pressure Switch-Controlled Accumulator Circuits
R. P. Esser — June, 1954

NUCLEAR ENERGY—What jobs are done HYDRAULICALLY?

In the June issue of AH, Robert Stoddard, of Baldwin-Lima-Hamilton's Eddystone Division, detailed the hydraulic circuit design used to control nuclear radiation from a reactor used for medical research. Oil at 1000 psi powered and controlled the opening of massive shutters. Shutter opening determined amount of thermal nuclear radiation which could pass into the treatment room. An important application—but auxiliary to the actual generation of nuclear power.

Here's a design story which tells how hydraulics is an integral part of a reactor—it's used to control the generation of nuclear power.

FUNDAMENTALS OF NUCLEAR REACTION—When an atom of Uranium 235 absorbs a neutron, it breaks up or fissions to yield an average of 2.5 neutrons and two fission products of nearly equal weight. The weights of the products of the fission are less than the weight of the original U235 atom. The lost weight is converted into energy which appears mostly as heat in the reactor.

A chain reaction occurs when the neutrons produced by one fission are captured by another U235 atom, which fissions to yield more neutrons to carry on the chain. During this process, however, neutrons are lost and do not react. When the number of neutrons produced equals the number lost, plus the number captured, the reaction is "critical", and will continue by itself.

Reactors are constructed with a greater amount of U235 fuel than is required to maintain critical state. If left uncontrolled, the number of fissions would increase very rapidly and endanger the reactor, i.e. it might melt from the heat produced. Control rods, containing neutron absorbing material, are inserted in the reactor core to maintain the reaction at a critical level. When the control rods are withdrawn, more fissions occur and more heat is produced. Conversely, inserting the control rods decreases the number of fissions and less heat is produced.

CONTROL OF NUCLEAR REACTOR RODS

. . . with an integral hydraulic servo

Design of a hydraulic control mechanism for a nuclear reactor poses many special problems. Reliability is a must. Use of atomically hot water as the hydraulic fluid is expedient for safety reasons. But this also creates problems. Here's a unique solution incorporating some unique concepts.

• By A. Richter

NUCLEAR reactors must be controlled to keep the rate of reaction at the desired level, and to prevent runaway reactions which could melt the reactor in a fraction of a second. This control is accomplished by insertion or removal of control rods which contain neutron absorbing material.

Three different types of rod action are required: *shim*, *control*, and *scram*. *Shim* rods adjust neutron

A. RICHTER, *Project Supervisor, Ford Instrument Co., Div. of Sperry Rand Corp.*

production for long term fluctuation and fuel burn-up. The *control* rod adjusts the number of neutrons produced for short term power fluctuations. *Scram* consists of dropping all the rods into the reactor fast enough to check the reaction.

Power reactors now being built, or planned in the near future, use pressurized water as a heat transfer medium. The reactor is enclosed in a large pressure vessel filled with water under high pressure to prevent boiling. The water circulates around the reactor core, carrying away heat generated by the nuclear reaction. Heated water is passed through a steam generator to produce steam to generate power in a conventional steam turbine-generator system. The hydraulic mechanism uses this pressurized water as the hydraulic fluid. All working parts are completely submerged.

DESIGN CONSIDERATIONS

Since piston position must be precisely controlled, the system must be essentially free from drifting, and leakage should be at a minimum. At the same time, the possibility of crevice corrosion makes it desirable to have a controlled amount of leakage passing all close fitting parts. Consideration must also be given to the low lubricating properties of water which will tend to increase wear.

The system chosen uses a feedback signal controlling pump output pressure. Pump capacity is made adequate to eliminate all leakage problems, and the feedback insures precise control of the position of the piston.

SYSTEM OPERATION

Heart of the system is a proportional hydraulic amplifier in the form of a spool valve. A simplified schematic of the spool valve is shown in Figure 1. If the valve is at the top of its travel, the output of the pump is connected directly to the center output port. Suction of the pump is drawn directly from the surrounding water. Output port is above ambient water pressure by the full output of the pump. If the spool is at the bottom of its travel, the suction side of the pump is connected to the center output port. Pump discharge is into the surrounding water. Pressure at the output port is then below the ambient pressure by the full pump discharge. At any intermediate spool position, the pressure at the output port will be intermediate between the two extremes.

The complete system is shown schematically in Figure 2. Output port of the spool valve is connected to the upper portion of the main drive cylinder. Pressure or suction at this port is applied to the top of the piston to balance the load applied to the piston rod from below.

The lead screw provides mechanical feedback of the position of the main drive piston. For example, if the piston tries to move downward, the lead screw transmits this motion to the spool valve. The spool shifts downward and decreases the pressure at its control port and on top of the piston. The decrease in pressure allows the ambient pressure below the piston to push it up, so the spool valve is returned to an equilibrium position just balancing the load applied. Similarly, if the piston tries to move upward, the lead screw moves the spool up and slightly increases the pressure above the piston. Position of the piston is determined by the relative length of lead screw between the piston and the spool.

Piston motion to move the control rods is obtained by rotating the lead screw with the shim motor. If the lead screw is screwed into the piston, the spool tends to fall and decrease the pressure above the piston. The piston will move upward a small amount to re-establish equilibrium. Continued rotation of the lead screw in the same direction causes the piston to rise. Reversing rotation direction of the lead screw will cause the piston to move down.

The system will compensate for changes in load and will also make available the full pump suction

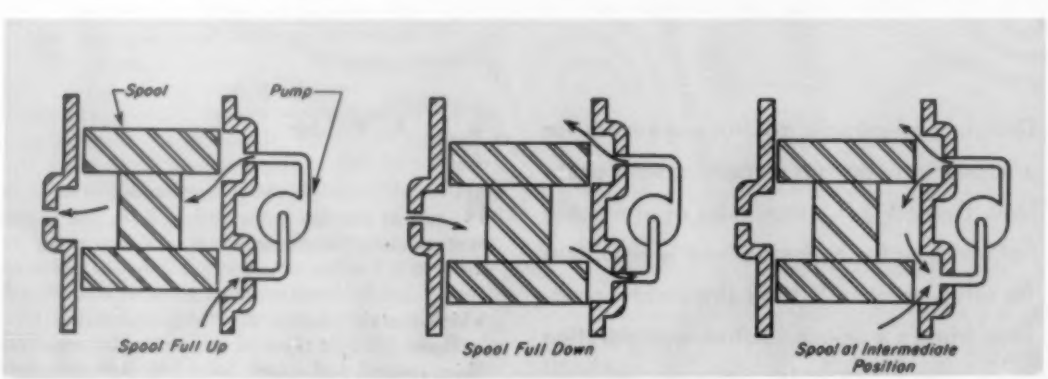


FIG. 1. SPOOL VALVE operates as hydraulic amplifier, with output above ambient pressure in up position, below ambient in down position.

or discharge pressure, should higher force be required to move a jammed rod. The pump is sized to provide adequate flow to overcome any leakage that may develop during the life of the equipment. Control signal power required is very small, being only that required to turn the lead screw, which is under no load. The main power for the system is derived from the pump. Power for the pump motor, however, need not be controlled and is drawn directly from the main power line.

If the reactor must be scrammed, in an emergency, the scram latch is de-energized. This allows the control rod to drop free of the piston and piston rod under its own weight. Falling into the reactor, the control rod will shut down the nuclear reaction. When the emergency condition is over, the control rod may be returned to service by driving the piston down to engage the scram latch, which is then energized. The control rod may then be moved in the normal fashion.

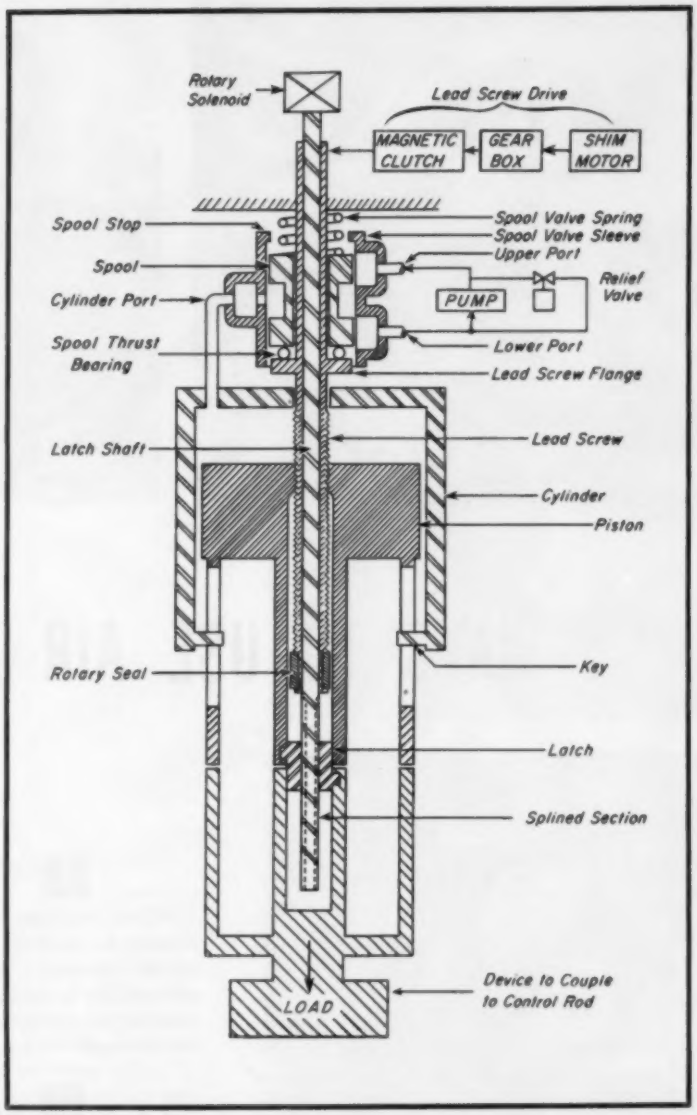


FIG. 2. CONTROL DRIVE MECHANISM is submerged in water ambient. Pressure or suction is applied to the top of the piston to balance load applied to the piston rod from below. Lead screw provides mechanical feedback of position of the main drive piston.

PUMP

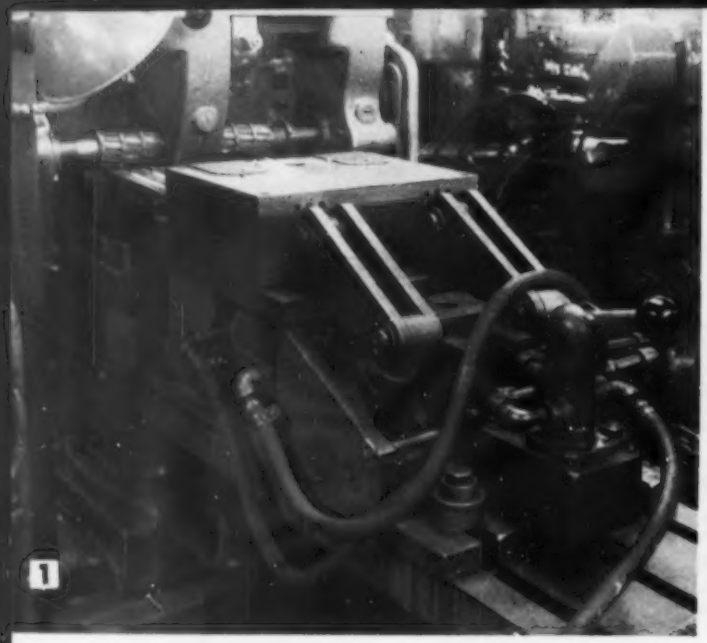
Type of pump selected will depend on requirements. In some cases, a high available force is required to move rods which may become jammed in the reactor core. In turn, the high force requires a high output pressure from the pump. A re-entrant turbine pump is generally adequate. If a high force is not specified, a simple centrifugal pump will generally be adequate to move the load imposed by the rod.

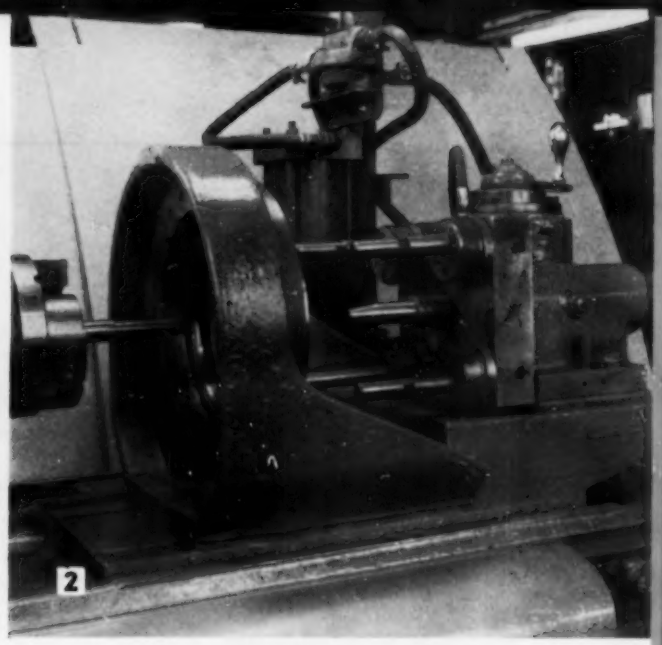
Either type of pump is driven by a special motor. The rotor is connected directly to the pump impeller. A stainless steel, non-magnetic pressure wall is placed between the rotor and stator of the pump drive motor to contain the pressurized water. Power for the motor can be drawn directly from the main power supply.

The system is fail-safe, since mechanical failures of various parts, pump supply power, etc., will always cause the rod to move down to reduce the neutron flux. Under no circumstances must the control be withdrawn from the reactor unless it is under control of the shim motor.

SPECIAL PROBLEMS

Water used as hydraulic fluid, although pure, is highly corrosive at 500 F. Therefore stainless steels were used for non-magnetic parts of the mechanisms, while a 17-4 precipitation hardened steel was used for magnetic portions. All of the electrical windings were placed outside the stainless steel pressure wall. ▼▼▼





8 WAYS TO USE AIR AND OIL . . . to

• By Thomas Baxter

Tool Design Engineer,
Leland Electric Canada Ltd.,
Guelph, Ontario, Canada

DIFFERENCE between profit and loss is often the ingenuity of the tool engineer who works out the means of getting a product made. Every company, regardless of product, has some similar manufacturing requirements.

Fluid power has been used in a variety of unusual ways to speed production of special purpose electric motors at Leland Electric Canada. Both new machinery and existing equipment have been modified to speed production, reduce human effort and produce a superior product. Pneumatics and hydraulics are both widely used to achieve these results.

1 CLAMPING WITH AIR

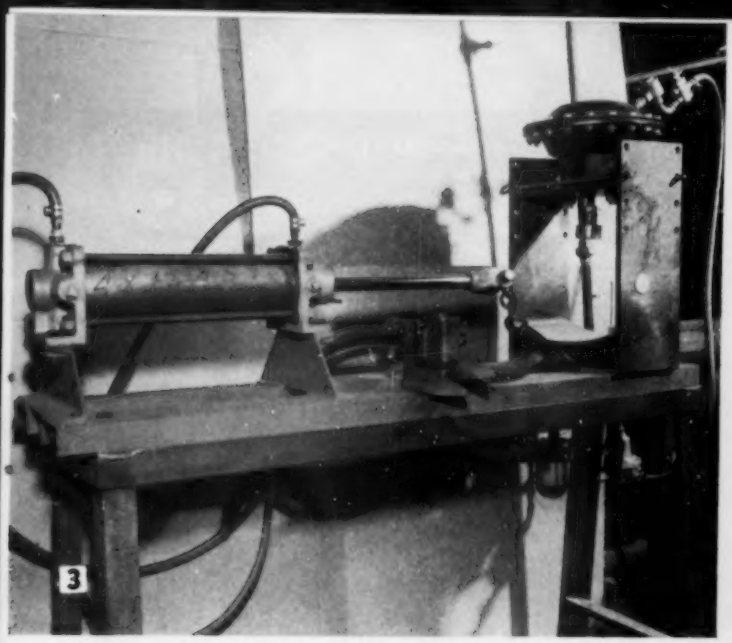
Milling of flats or keyways on six shafts simultaneously is speeded by using a special pneumatically-operated clamping fixture. Two 3-in. stroke cylinders, actuated by a manual two-position, four-way valve, operate toggle linkages to apply equal holding pressure to the six shafts.

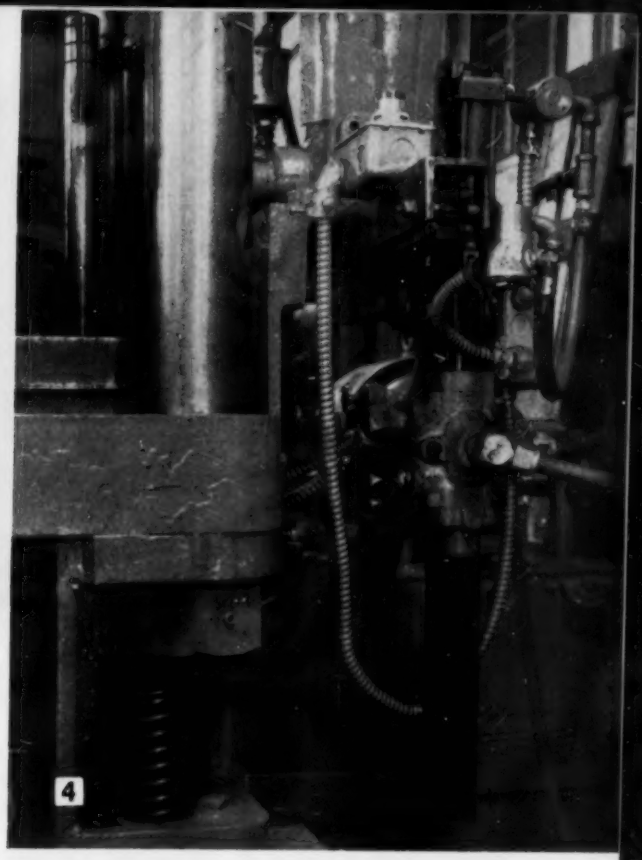
2 CLAMPING WITH OIL

Clamping of motor end bells is more positive on a Heald Boring machine despite rough surface of the end bell using hydraulic pressure. Four 1-in. cylinders machined in a block work against a holding plate to secure the work in the machine. An air-operated booster provides 750 psi oil to the clamp cylinders. A tapered center positions the end bell properly before holding pressure is applied. A two-position, four-way manual valve controls air to the booster.

3 SALVAGING PARTS

Removing windings from scrap stator assemblies is speeded by first cutting the stator end, then clamping it with a 3000-lb diaphragm-type air chamber, and finally pulling the windings off with a hook at the end of the piston rod of a 4-in. bore by 12-in. stroke air cylinder.

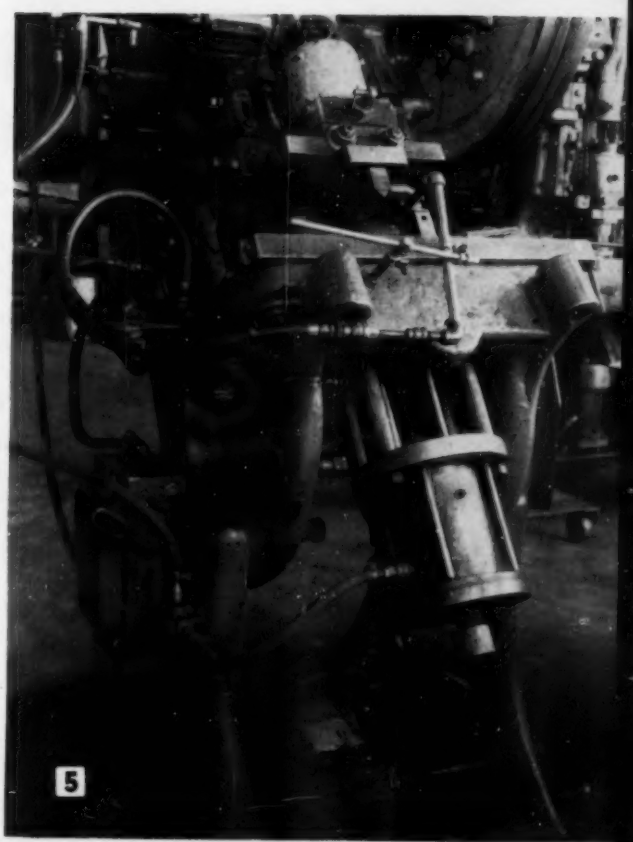




improve production

4 AUTOMATIC RIVETING

Stator riveting was made automatic by the addition of air cylinders and valves to operate the main hydraulic press control valve. The lever-operated hydraulic valve is spring returned to the center or *off* position. On the modified machine, when the operator has loaded a stator, he presses the start button. This energizes a relay and holding circuit to energize a solenoid air valve which in turn energizes a pneumatic cylinder to operate the hydraulic valve and start the press ram moving downward. When the press ram reaches the bottom of its stroke it energizes a limit switch which is connected to a short duration timer to control a squeeze period at the bottom of the stroke. At the end of the squeeze period, the timer disconnects the *down* relay, and energizes an *up* relay. This energizes another air valve and cylinder to move the hydraulic valve lever to the *up* position. When the top of the stroke is reached another limit switch is tripped to exhaust the *up* cylinder and allow the valve to return to neutral.



5 CUSHIONING PRESS DIE

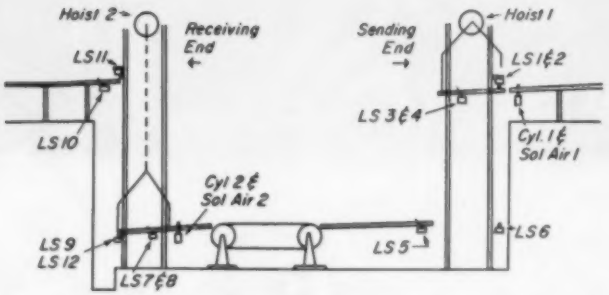
Die cushioning on some die press jobs is pneumatic. This eliminates cushion springs. The system used eliminates the need for the large surge tanks usually as-

6

sociated with pneumatic cushioning. A single-acting cylinder serves as the cushion. A quick-exhaust valve opens to reduce cushion force if it exceeds a preset value.

6 HANDLING PARTS

Rotor lamination sorting or alignment is performed automatically using a pneumatic cylinder to actuate a reciprocating rack and pinion drive. Laminations are stacked randomly on four arbors about 12 in. long. Each lamination has a keyway. The lower portion of the arbor has a raised key. Arbors are oscillated by the cylinder, rack and pinion until all lamination keys align with the arbor key so that the laminations slide down onto the keyed portion of the arbor. Any of the arbors may be removed without stopping machine operation by disengaging the pinion from the rack. Reciprocation is controlled by rack-operated pilot valves which reverse air flow to the cylinder at the ends of the stroke.



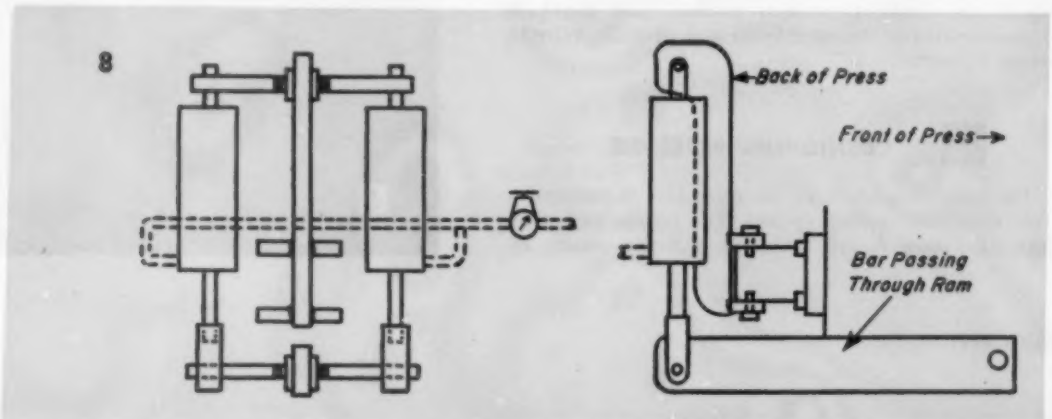
7

7 CONTROL OF CONVEYORS

Traffic control on a conveyor and hoisting system for carrying completed electric motors from the test department to the shipping department is provided by pneumatic cylinders. For most of its length the conveyor is in a trench. Motors being fed are lowered into the trench and then lifted out at the end of their trip by automatic elevators. When one of the hoists is in operation, air cylinders controlled by limit switches raise blocks to prevent any other motor coming along from tumbling into the abyss. Once the block is raised by a motor being placed on the hoist platform, it is not lowered until the hoist returns to that position. Overall system setup is such that motors are blocked at the inlet end unless they are being removed at the outlet end.

8 COUNTERBALANCING A PRESS RAM

Punching motor laminations was speeded by using two 4-in. diameter by 12-in. stroke air cylinders to counterbalance the 1800-lb. ram. Cylinders are mounted on a common strap passing through the knockout slot. Tops of the cylinders are open and regulated 70 psi air is connected to the other sides. A quick exhaust valve prevents any dangerous rise in pressure due to ram loading. This system has reduced the necessity of frequent adjustments to the clutch and the brake.



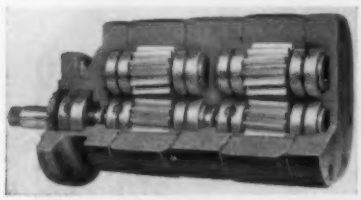
8

Hydraulic Motors Drive Crawler At Two Speeds

Two "Commercial" oil hydraulic tandem motors propel the crawlers of this Gradall. In fact you might say that there are really four motors as each tandem motor consists of two single motors. Here is how they operate to give the Multi-Purpose Gradall low and high speed ranges.

single or combined output

Two single motors are mounted with one common drive shaft. When fluid power from the pump source is directed by simple valving into just one of the single motors, the shaft rotates in the high speed range desired for propelling the crawlers where the going is on good level terrain. The other single motor on the same shaft receives no input and therefore idles at motor speed. When conditions are otherwise and low speed is required, it is accomplished by simply valving half of the fluid into each of the single motors. Because the volume feeding into each is less, the speed is reduced. Both tandem motors can be stopped or operated in either direction to give forward or backward travel to the crawlers.



Look at the heavy duty bearings which absorb the shaft and gear loadings. Perfect alignment of the matched helical gears results in more efficient, smoother, quieter and longer life operation.

50 h.p. output

As an example, an "H" Series single shaft tandem motor receiving an input of about 15 gpm at 1200 psi would rotate at 1200 rpm when the entire input was directed to only one of the two single motors When this input is split between both motors, their speed would drop to 600 rpm. The example is based on two single motors mounted in tandem on a common shaft with each motor having gears of 1 inch face. Motors with larger gear widths are available to develop a rated output up to 50 h.p.

important advantages

All of this is accomplished without shifting of gears. Power takeoffs, clutches and gear transmissions are eliminated. Here is another proven application where fluid power is piped around corners. It is successful because space is conserved and high initial cost mechanical drives with their constant maintenance problem are eliminated. Write to Dept. A-36, The Commercial Shearing and Stamping Company, Youngstown, Ohio,

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HYDRAULICS BASIC ARTICLE

Flow control or metering of oil is of prime importance in many hydraulic systems. This is especially true in machine tool circuits, where rates of movement of cylinders, fluid motors, work spindles, and rates of travel of tool heads and slides must be controlled within very close limits.

FLOW CONTROL VALVES and FEED CIRCUITS

• By Peter Coffaro

THERE are many flow control valves on the market today. Gate, plug and needle valves are the more common types of simple flow control valves. While these types may be used to open or close lines, or control the rate of flow through a line, they are not generally used when accurate rate control is required. Since pressures are determined by work loads, it is necessary to control the pressure because of its effect on flow.

Basically, there are only two types of metering systems in use: Throttling system, in a constant delivery system, and variable quantity system, where pump delivery is varied to get the desired rate of flow.

• **Pressure compensated**—In machine tool circuits where rates of speed have to be constant with varying loads, flow rates must remain constant to insure constant rate of travel of table, quill, or head. In these applications, pressure compensated flow control valves are a necessity; they keep flow rates uniform regardless of work load changes.

No other type of metering valve does this. A non-pressure-compensated flow-control valve, such as a needle valve or fixed restriction, allows changes in flow rates with pressure fluctuations. In drilling and milling circuits, this will cause vibrations, chatter marks and broken tools.

PETER COFFARO, *The Avey Div. of The Motch & Merryweather Machinery Co., Cincinnati.*

Figure 2 illustrates in schematic form, a pressure compensated flow control valve. This valve features a hydraulically balanced plunger. Any fluctuation of pressure at either inlet or outlet ports will momentarily unbalance the forces acting on the compensator spool, causing it to move to the right or left and changing the setting or orifice. This changes pressure drop through the orifice to compensate for pressure fluctuations. The hydraulically balanced plunger is constantly seeking a position which maintains a differential pressure between the chamber and outlet port, equal to the force of the spring. The spring exerts a thrust load against the

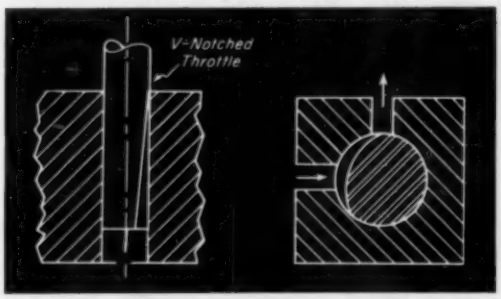


FIG. 1, TWO TYPES of metering valves. *A* has a notched throttle, while *B* uses an eccentric type. Ports or orifices are relatively large to prevent clogging.

spool, in addition to the hydraulic force in the spring chamber. Therefore, the pressure drop through the metering spool orifice remains constant, resulting in constant flow through the valve and the actuator.

As shown, the throttle is machined and calibrated so that rotating it in one direction increases the size of the metering orifice, while rotating in the opposite direction decreases the orifice. The size of the orifice and the depth of eccentricity on the throttle determine the amount of flow through the valve.

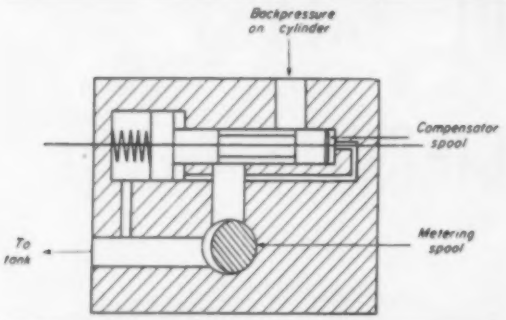


FIG. 2. PRESSURE-COMPENSATED, flow-control valve features hydraulically balanced plunger.

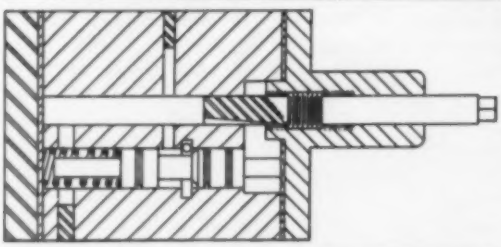


FIG. 3. THIS VALVE is similar to Figure 2, but has a V-notch with range of flow in direct proportion to the thread pitch cut on the throttle.

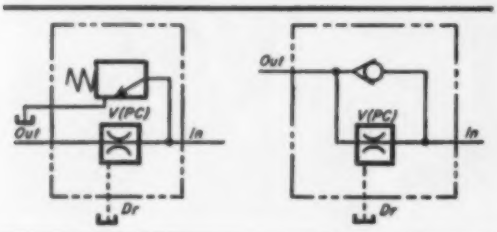


FIG. 4. FLOW-CONTROL VALVES are available with built-in relief *A*, or built-in check *B*, for free flow in one direction.

It is obvious that for a valve of this type, two or more throttles can be machined, with different eccentricities, to change the flow ranges from 10 to 75, and from 50 to 150 cipm or more.

• **Slow travel**—When feed circuits are being designed for very slow travel rates, there are several problems confronting the machine designer. Flow control valves operate fairly smoothly at their high range of flow. At low ranges they tend to give erratic control of the actuator. Most valve manufacturers will not stand behind the performance of their valves when metered flow is to be below 5 cipm.

In certain feed circuits, such as gun drilling, or milling, where feed rates are less than 1-in/min, a large cylinder has to be used to get proper flow, since speed is a function of oil flow and cylinder size, see Chart 1. It will readily be seen then, that if travel of ½-in. or less is required, a 4-in. bore cylinder should be used.

There are some disadvantages with this arrangement. For example, larger pump capacity is needed for rapid traverse to and from the work. However, if smooth and cool systems are required, the advantages will outweigh the disadvantages, as the pump can be operated with less pressure so as to minimize heat.

• **Circuits**—The circuit shown in Figure 5 is a most dependable system, if designed in such a manner that the depressing of the cam is necessary to obtain the transition. The circuit will fail safe if the deceleration valve should happen to stick. The full forward stroke will be at a metered rate. Being a very reliable system, feed may be started close to the work, thus saving rapid advance time.

SIZING CYLINDERS FOR SMALL FEED RATES BASED ON METER-OUT, SINGLE-ENDED CYLINDERS

4-in. bore cylinder

4-in. bore area = 12.566 sq in.
1½-in. dia. rod area = 1.767 sq in.

Effective area = 10.799 sq in.

3-in. bore cylinder

3-in. bore area = 7.068 sq in.
1¼-in. dia. rod area = 1.227 sq in.

Effective area = 5.841 sq in.

$$\frac{\text{Cu. in/min (metered)}}{\text{Effective area (sq in.)}} = \text{in/min (travel)}$$

$$\frac{5}{10.799} = .463 \text{ in/min with 4-in. bore cylinder}$$

$$\frac{5}{5.84} = .856 \text{ in/min with 3-in. bore cylinder}$$

With the variable, pressure-compensated, flow-control valve, deceleration valve, and a cam so designed, a very dependable and smooth system is assured. It is possible to obtain jump or intermittent rapid advance and feed by simply designing the cam with corresponding rises and falls.

There are many variations of this basic circuit which have proved successful. Figure 6 shows this same circuit carried one step further. Here, with two pressure-compensated, flow-control valves, and two deceleration valves, it is possible to have multiple controlled rates. This circuit is used when rapid advance, feed and fine feed are required. Step drilling or step milling might use this type of control.

• **Differential feed**—A novel differential feed circuit is shown in Figure 7. This system is used when faster forward speed is desired, without the addition of a larger pump. Here is a theoretical problem with this circuit, using a differential cylinder (2:1) as well as the differential circuit.

Cylinder bore = 3.0 in.
Area = 7.06 sq in.
Rod dia. = 2.0 in.
Area = 3.14 sq in.
Effective area = 3.92 sq in.

For rapid advance, solenoid *B* is energized on valve 2, sending pilot pressure to pilot *Y*, moving valve spool to the left. Full pump pressure is now directed to the head end of the cylinder. Exhaust oil is directed through valve 4 and into main pres-

FIG. 5. CAM-OPERATED VALVE facilitates transition from rapid traverse to feed.

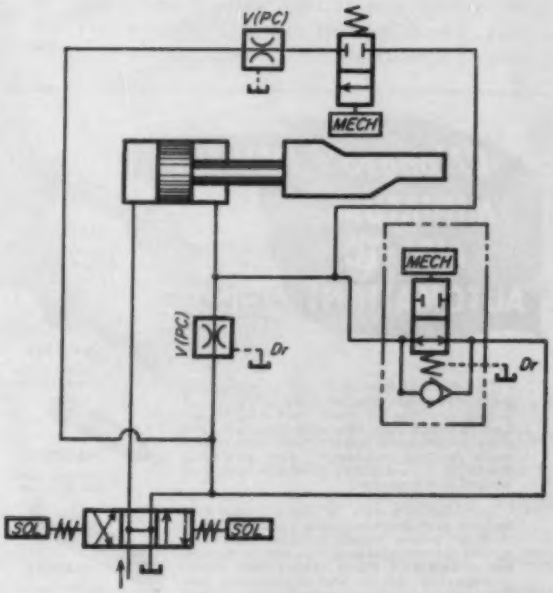
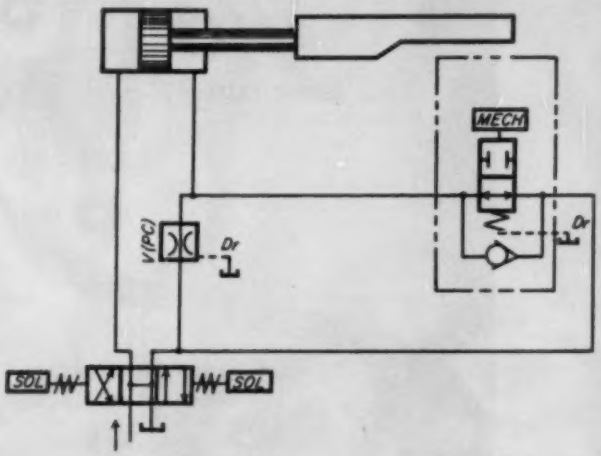


FIG. 6. MULTIPLE FLOW CONTROL rates are possible with this circuit, which features two pressure-compensated, flow-control valves and two deceleration valves.



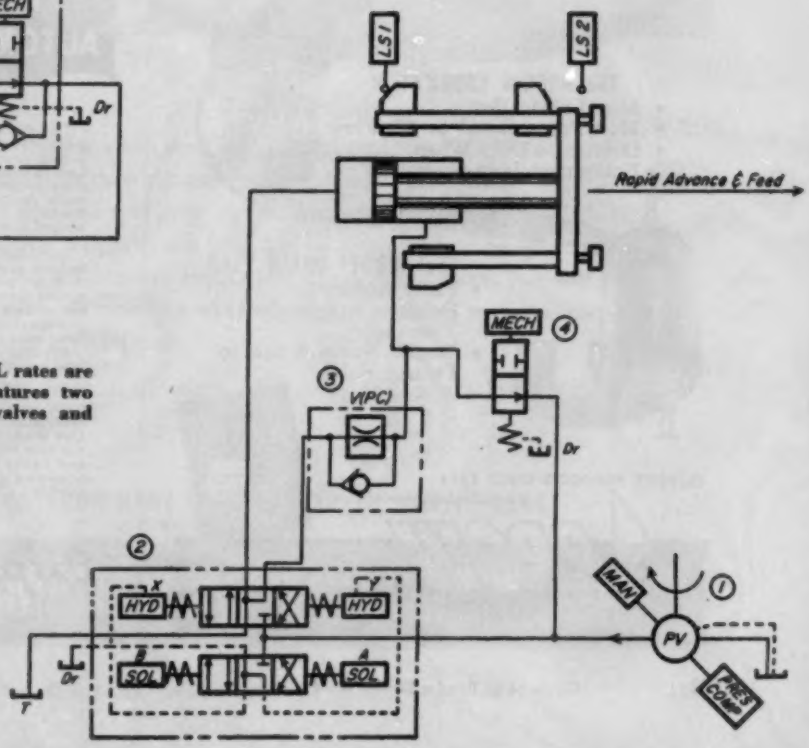


FIG. 7. FASTER FORWARD SPEED without adding pump capacity is a feature of this differential feed circuit.

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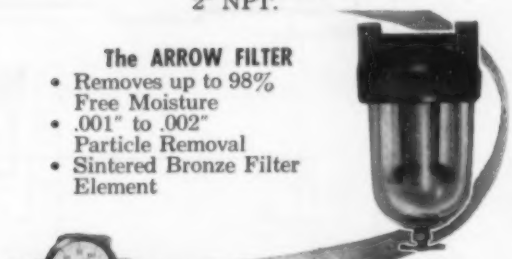

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FLOW CONTROL VALVES

sure line, through valve 2 and to head end of cylinder. This gives approximately a 2:1 ratio between oil into the cylinder and pump delivery. The increased speed is at the expense of working force, which is not really needed in rapid advance.

Output force = effective area (sq in.) x psi

3.92 x 300 psi = 1176 lbs

For feed, solenoid *B* is still energized, full pump pressure is directed through valve 2, and to head end of cylinder. Cam on valve 4 has been depressed by feed dog, so oil is blocked through valve 4 and has to go through valve 3, which is an adjustable pressure-compensated flow-control valve. It then goes through tank port of valve 2 and back to tank.

Feed rate is a function of the annular area of the piston in the cylinder, and adjusted throttle opening of valve 3.

Output force = cylinder area x psi

7.06 x 300 psi = 2118 lbs

Rapid return at the preset limit of the forward stroke, a limit switch is tripped, energizing solenoid *A* on valve 2. Full pump pressure is now directed through valve 2, through ball check in valve 3, and to rod end of cylinder. Exhaust oil from head end of cylinder goes through valve 2 and directly to tank. The differential rod (2:1) gives a very fast rate of rapid return. ▼▼▼

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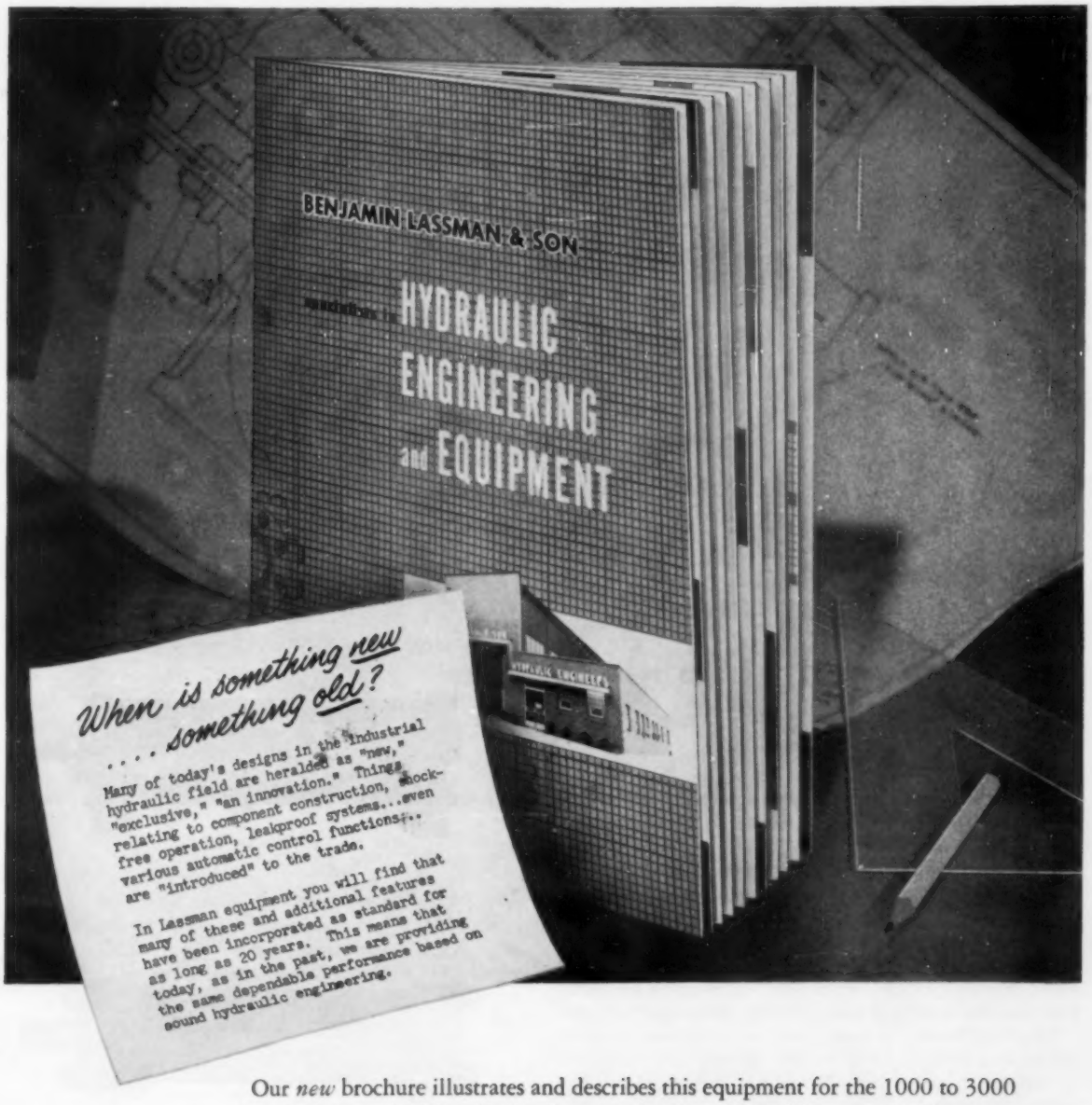
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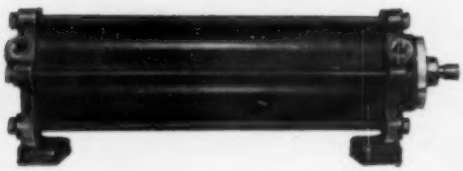

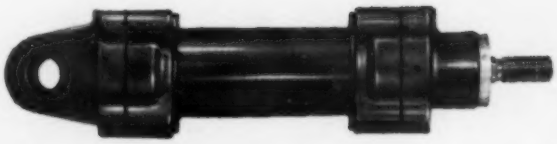

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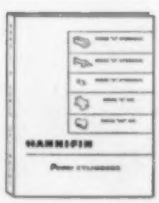
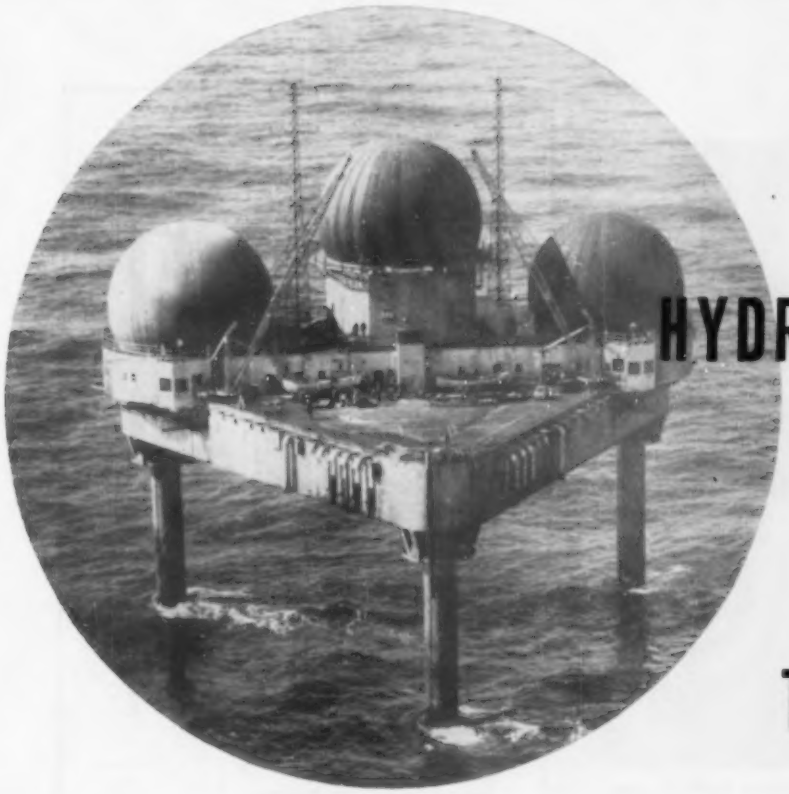




HYDRAULICS HOISTS TEXAS TOWERS

• By Leroy Nixon and G. R. Pittman

ANOTHER place where the tremendous muscles of hydraulics are being exercised is in the erection of the giant Texas Towers, which are a vital link in America's radar warning system. The name Texas Tower comes from the initial application of these large platforms perched on stilts above the ocean's surface to support oil well drilling rigs in the Gulf of Mexico off the Texas coast.

Method of erection of the towers is to float them into place and then hydraulically lower the supporting pilings to the ocean floor using the floating platform as the working area. In addition to the supporting pilings additional temporary pilings are to be used in the lifting process. When the supporting members have been driven as deep as necessary into the ocean floor, the platform is hoisted up the pilings until correct elevation above the ocean surface is reached. Third of these units was placed in position this summer off the New England coast.

The platform is a tremendous steel box, triangular in shape and measuring 200 ft on a side and 20 ft deep, weighing about 6000 tons. Oil power lifts this weight. Driving the pilings, supporting legs or spuds as they are known to oil well people, is also performed by hydraulics. The same system is used to do both jobs.

LEROY NIXON, *Design Consultant—Bridge Div., John A. Roebling's Sons Corp., Trenton, N.J.* G. R. PITTMAN, *Sales Manager, Hydraulic Power Div., The Hydraulic Press Mfg. Co., Mt. Gilead, Ohio*

HOISTING AND DRIVING SYSTEM

Large hydraulic cylinders with a stroke of 4 ft are mounted vertically around the spuds, Figure 1. Cylinders are attached to the deck by trunnions. At the end of the piston rod and at the opposite end of the cylinder, large clamps hold each cylinder to two large strands of wire rope. Strands of wire rope are attached to the tops of the spuds, Figure 2, and the opposite ends are attached to the spud below the surface of the water. Wire rope strands are 2⅛ in. in diameter and are picturesquely called *bowstrings*. Alternate extension and retraction of the cylinders first with lower clamp holding the ropes and then with the upper clamp holding while the other is released, Figure 3, first forces the piling or spud into the ocean bottom. Speed of this operation is 6½ in. per min. When spuds are driven deep enough to support the weight of the platform, the same process lifts the platform until it is 67 ft above the waves. This system was developed by the Bridge Div., John A. Roebling's Sons Corp.

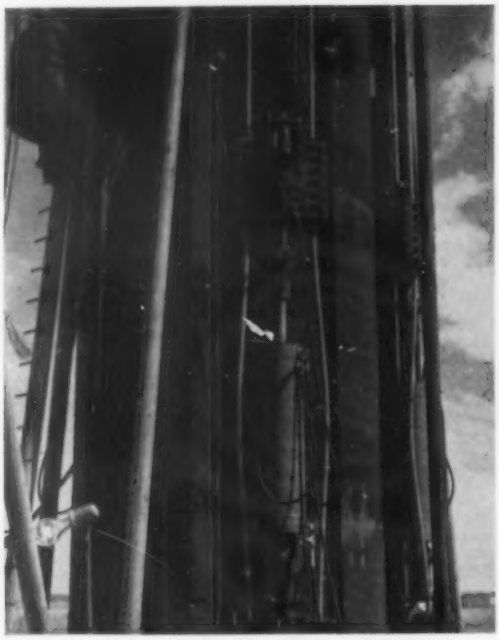


Fig. 1. Two of the hydraulic cylinders used for raising the Texas Tower are shown in position here. Flexible lines to the cylinders used for actuating the upper clamp are also visible. One of the clamp operating cylinders is between the two springs which are an additional clamp closing means.

Fig. 2. Cables by which the lifting cylinders pull themselves and the platform up are strung from the tops of the spuds to a point below the water surface.

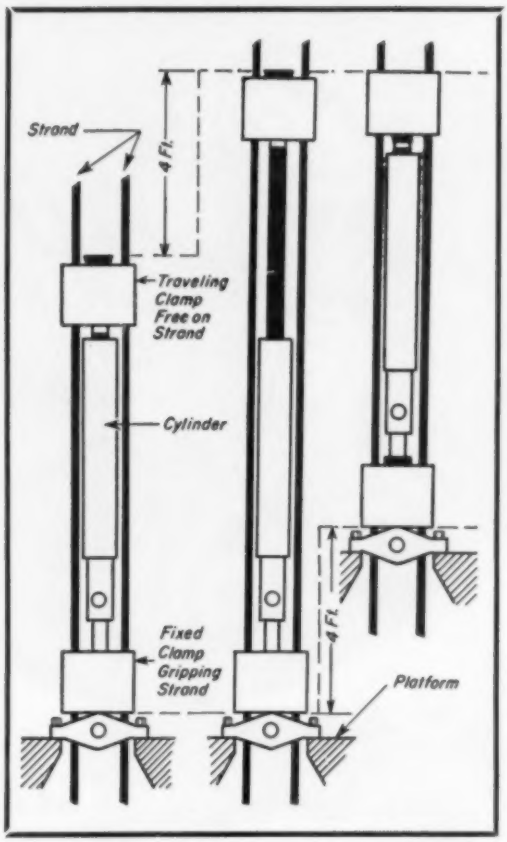


Fig. 3. Platform of the Texas Tower is elevated by hydraulic cylinders in a manner which might be compared to a boy shinnying up a rope. Steps in the sequence of events are: (1) Fixed clamp grips the strands and the travelling clamp is free on the strands. (2) The cylinders are extended and then the upper or travelling clamp grasps the cables and the lower clamp is released. (3) Cylinders are retracted to raise the platform 4 ft.

When the platform is at correct height, the permanent spuds are welded to the platform and cemented in place in the ocean bottom. The lifting system is then used to remove the temporary spuds by reversing the procedure. Three permanent legs, one at each corner of the platform, then hold the completed tower.

HYDRAULIC CIRCUIT

As shown by the circuit diagram, Figure 4, hydraulic pressure is also used to engage and disengage the wire rope clamps. Small hydraulic cylinders, which are a part of the clamp assembly, move the sections of the clamp relative to each other to either grasp the wire rope firmly or disengage it as the operating cycle demands.

Springs are also used to assure closing of the clamps in the event of total failure of the hydraulics.

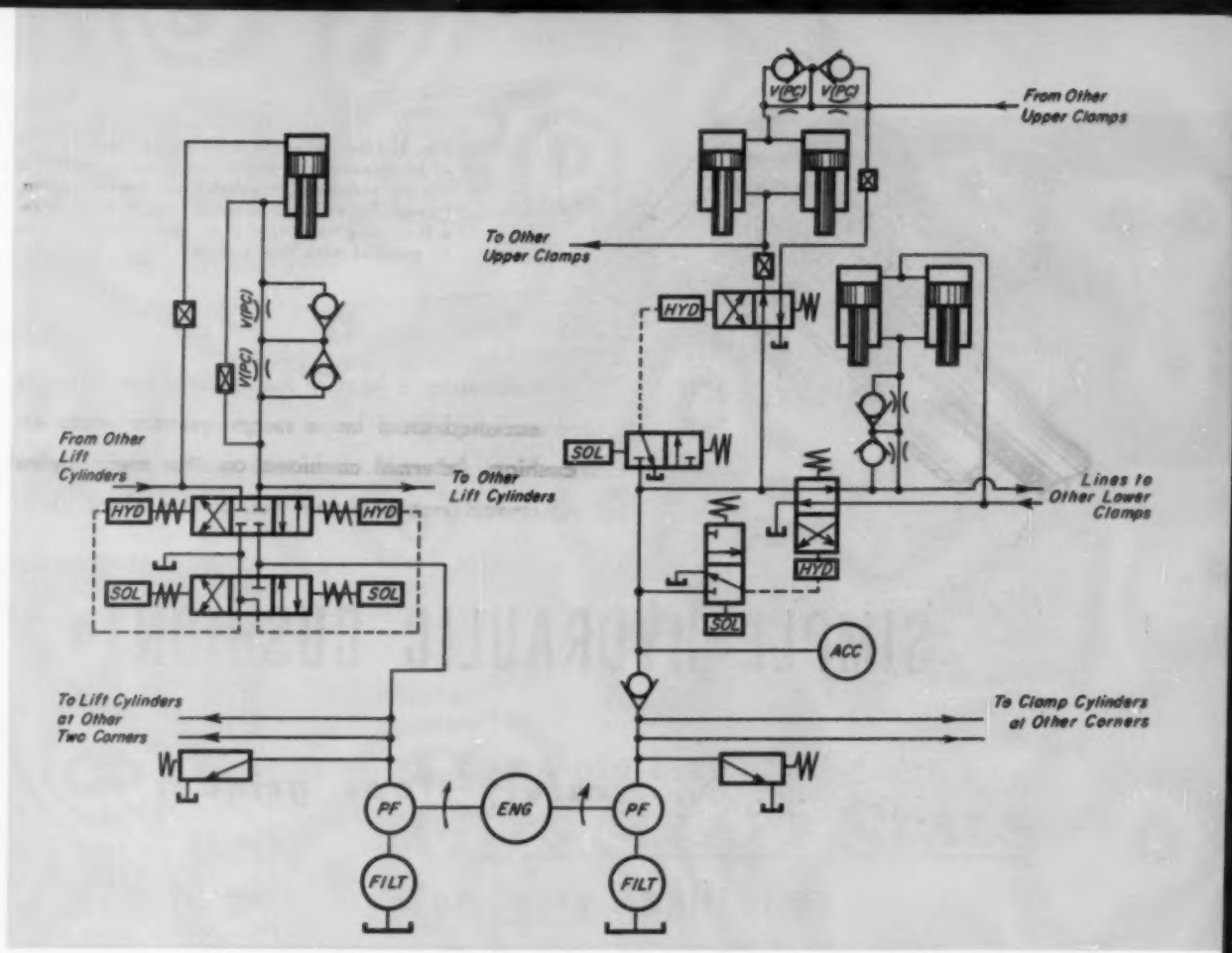


Fig. 4. Circuit diagram of the hydraulic system used to erect the Texas Towers.

Two rather unusual hydraulic design problems had to be solved in the lifting of the Texas Towers. First was the synchronization of 28 cylinders used for raising the platform plus 8 used for lowering the spuds. Second was the elimination of excessive pressure drops in lines that were over 70 ft. long.

Proper line sizing and careful design to keep the number of bends and fittings in the lines to a minimum solved the pressure drop problem. Despite the distances the oil had to be pumped, actual pressure loss in the completed system was only 50 psi.

Circuit diagram, Figure 4, shows that one pump is used to power all the lift cylinders. All clamp and unclamp cylinders are driven by another pump. A diesel engine governed to run at constant speed drives both pumps through a chain and sprocket, Figure 5. Lift pump capacity is 110 gpm. Clamp pump capacity is 50 gpm. The lifting circuit operates at 3200 psi, and the clamp circuit at somewhat less than 2500 psi.

The main power unit is located at the approximate center of the platform and oil is piped through three manifold lines to the three corners of the deck. One solenoid-controlled pilot-operated valve at each corner controls the cylinders at that corner. Two additional valves per corner control clamping and unclamping. One valve controls the lower

Fig. 5. Main hydraulic power unit consists of a diesel engine driving two pumps. Pumps have capacities of 50 and 110 gpm. The unit is located at the approximate center of the deck.

clamps while the other controls the upper clamps.

All valves are controlled from a central control panel measuring 16 by 20 in. On the panel, a lever

Continued on page 112

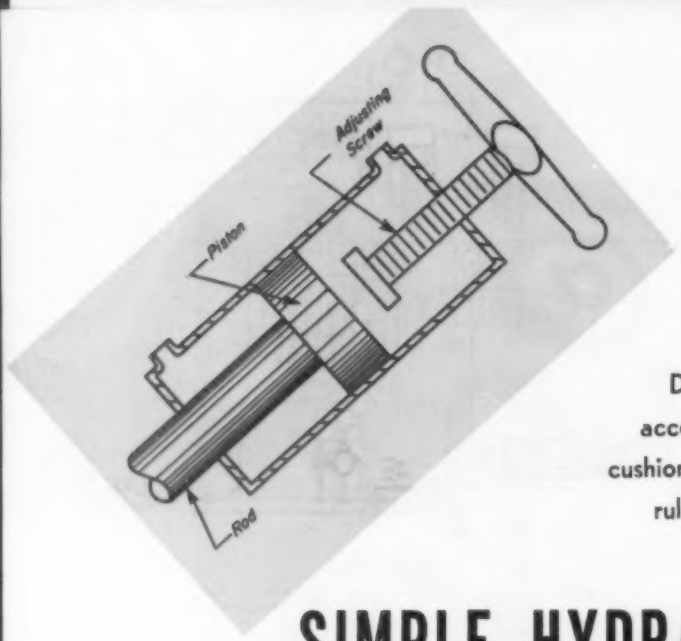


Fig. 1. Cushioning to allow shock-free reversal of an actuator cylinder at any point in its travel can be provided by connecting an adjustable, free-piston cylinder such as this in series with a throttling valve and then connecting the two in parallel with the actuator.

Decelerating a heavily loaded machine table is accomplished on a large grinder with an external cushion. Internal cushions on the main cylinder were ruled out because full piston stroke is not used.

SIMPLE HYDRAULIC CUSHION

. . . safely stops grinder table

● By Joseph L. Poggie

WITH many new metals and alloys, the quality of the finish imparted in a machining process is definitely improved when table reciprocation speeds are high. Of course, production rates increase as table speeds increase. When a machine table is reciprocated at high speed, some means of controlling deceleration and the shock accompanying rapid deceleration and reversal must be incorporated.

In most machines with hydraulically reciprocated tables, deceleration and shock are controlled by building buffers or cushions into the table-actuating cylinder. Cushions restrict flow of fluid as the piston nears the end of its stroke and thus control deceleration. However, this system functions only as long as full table stroke is used. If the workpiece or pieces are such as to occupy the whole table and the surface to be machined is small, only a portion of the total travel is necessary. In such a case, the cushion effect must be sacrificed to obtain higher production or the full stroke must be used. Neither of these is a happy choice.

JOSEPH L. POGGIE, *Development Engineering Section, Republic Aviation Corp., Farmingham, L. I., N. Y.*

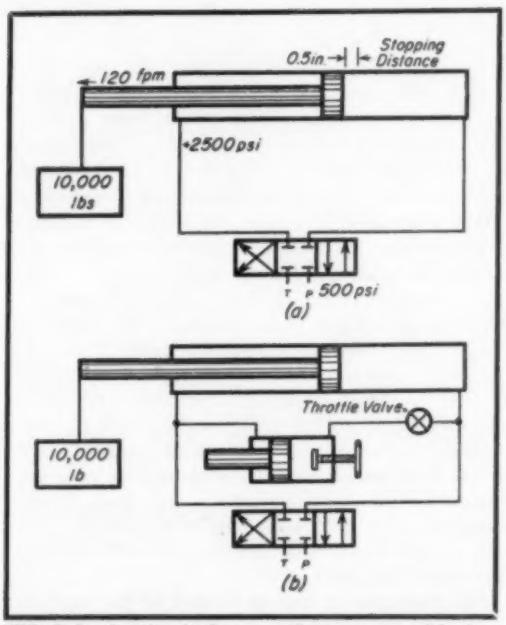
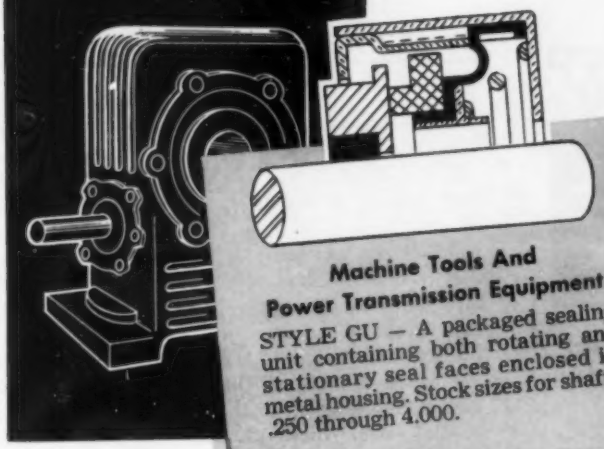


FIG. 2. In the circuit shown at the top, no cushioning is used. For the conditions shown, surge pressures of 2500 psi will be generated. With the adjustable cushion cylinder and needle valve in parallel with the actuator, bottom, stopping distance, deceleration rate and surge pressures may be limited to any desired value.



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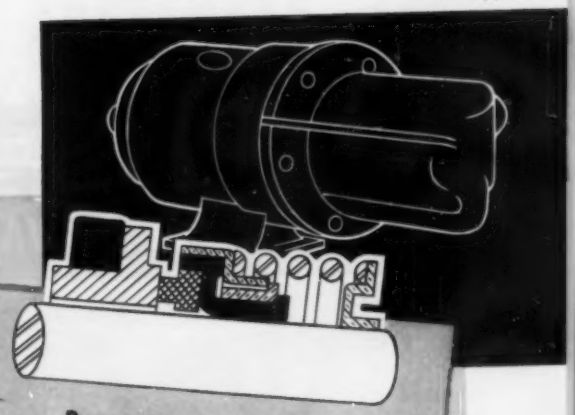

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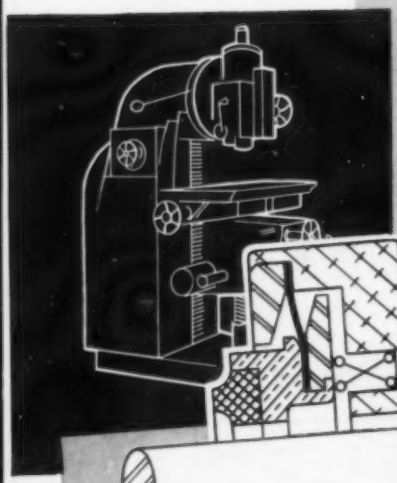

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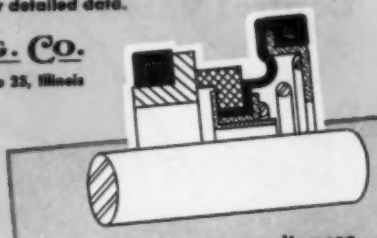

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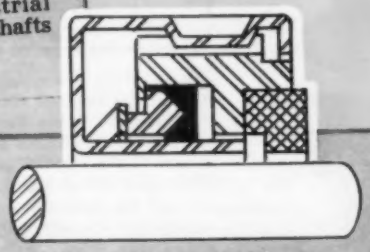

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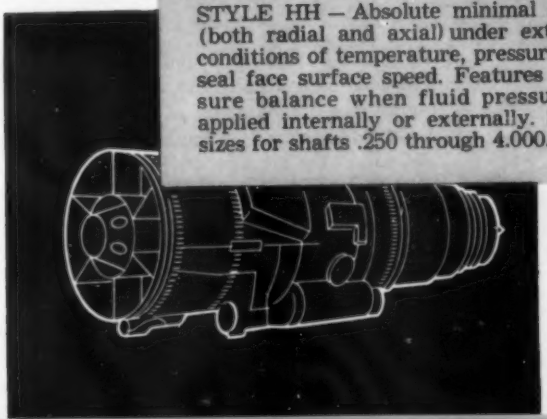

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SIMPLE HYDRAULIC CUSHION

• **Short-Stroke Cushion**—To provide table deceleration on a large grinder, a short-stroke cushion was developed. Table weight and work load total 2000 pounds. It was desired to operate this particular machine at 90 fpm. However, at 60 fpm the machine vibrated badly at the end of each stroke, the workpiece moved in the chuck and the entire machine moved about ¼ in. across the floor with each stroke. When speed was increased to 90 fpm, fittings and tubing split because of hydraulic shock.

Cushion used is a cylinder, with a free piston and an adjusting screw, Figure 1, in series with a needle valve. These elements are connected in parallel with the actuating cylinder. Areas of piston and rod ends of a piston used in this way should be proportional to the areas of the actuator with which they are used. For example, if areas of piston and rod end of the actuator are in the ratio of 2:1, piston and rod end areas of the buffer should be in the ratio of 2:1. This makes the cushion effect the same for both travel directions.

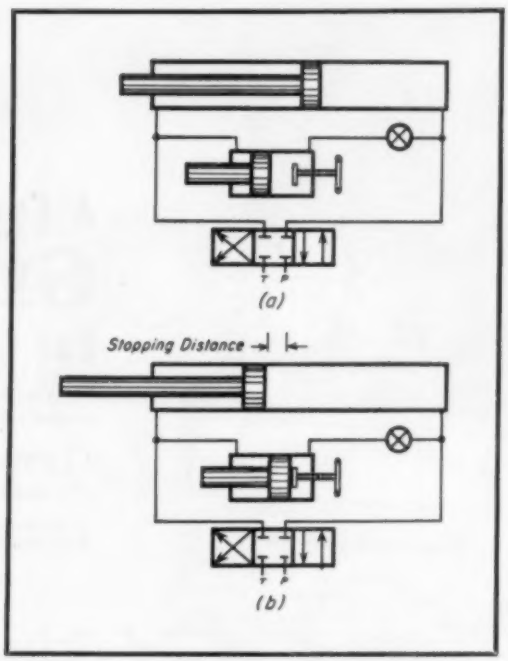


Fig. 3. With the actuator piston moving to the left, *a*, and the control valve closed, the actuator piston continues to move forcing oil into the rod end of the cushion cylinder. Piston of the cushion cylinder moves to the right displacing oil from the blank end. This oil is throttled through the valve to the blank end of the actuator until the cushion piston comes up against the adjustable stop, *b*. The actuator cylinder then stops. With proper adjustment of the throttling valve and the cushion stop, actuator piston velocity is nearly zero by the time the stop is reached.

Concluded on page 112

. . . Fluid Power news

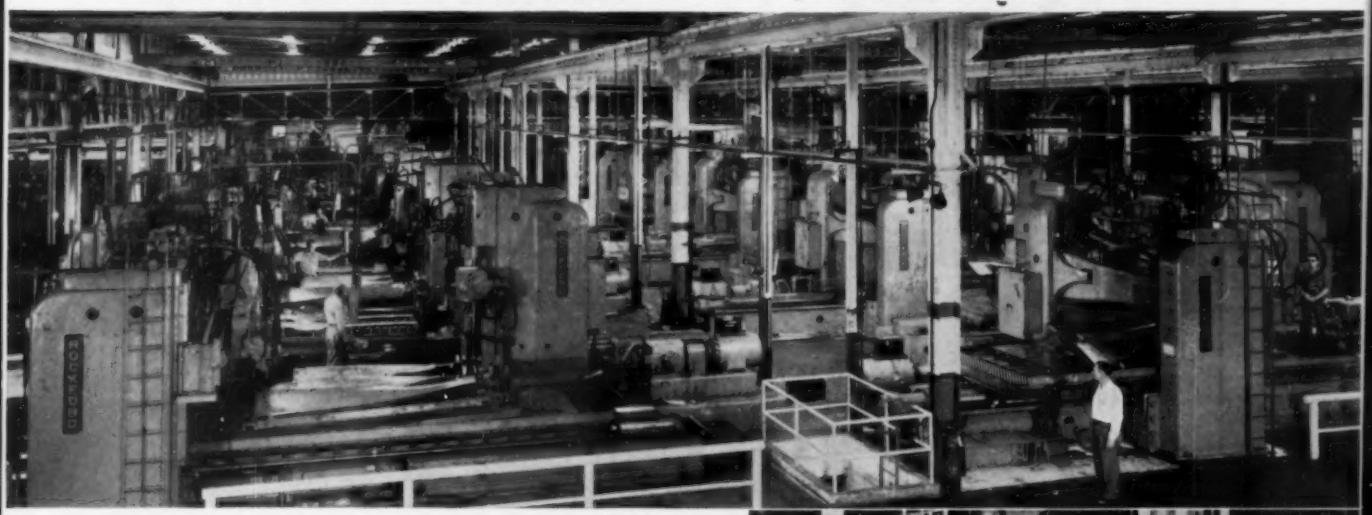
REPORT NO. 11,600 AID TO MACHINE DESIGN PROGRESS

From Oilgear Application-Engineering Files

HOW OILGEAR ENGINEERING TEAMWORK AIDS MACHINE DESIGN PROGRESS

CUSTOMER: Rockford Machine Tool Company

DATA: Application of Fluid Power system to planers that mass-duplicate the airfoil on new, solid, forged steel propeller blades. Six years has been spent on the development and manufacturing methods to produce this new blade. Planers to be equipped with tracer attachments to machine blades from master templates. Desired profile is completely machined to proper thickness . . . maintaining accurate airfoil on both sides of blade. Requirements: extreme accuracy; flexibility of control; elimination of shock, vibration and gear marks on work; independent, fast cutting and return speeds to keep costs to a minimum.



SOLUTION: Shown above are 20 Oilgear-equipped, Rockford Hy-Draulic planers machining aircraft propeller blades. Closeup (right) shows how Rockford's hydraulically operated "Kopy-Kats" can mass-duplicate four of these new-type, steel blades simultaneously from master templates. Rockford Machine Tool says of this set up, "The inherent advantages of hydraulic drive and control make this gigantic installation an extremely powerful production unit. Hydraulic drive is a natural for reciprocating machine tools. It's being proven daily in the world's finest machine shops." This is but *one* example of the ever increasing application of Oilgear-equipped machine tools. Rockford, and other designers and builders of tools for industry, have discovered that Oilgear *Application-Engineering* means cooperation and teamwork in supplying new production requirements . . . that Oilgear is more than just an "off-the-shelf" source of supply . . . that Oilgear is a Fluid Power design and engineering service based on over 35 years of pioneering and knowledge in precision, "Any-Speed" control, and efficient linear and rotary power systems. Because of this cooperative teamwork in solving problems—coupled with progressively engineered, trouble-free, dependable, Fluid Power control and drive systems—manufacturers have come to trust and depend upon Oilgear . . . the name that protects and enhances "OEM's" reputation, and assures satisfied users.

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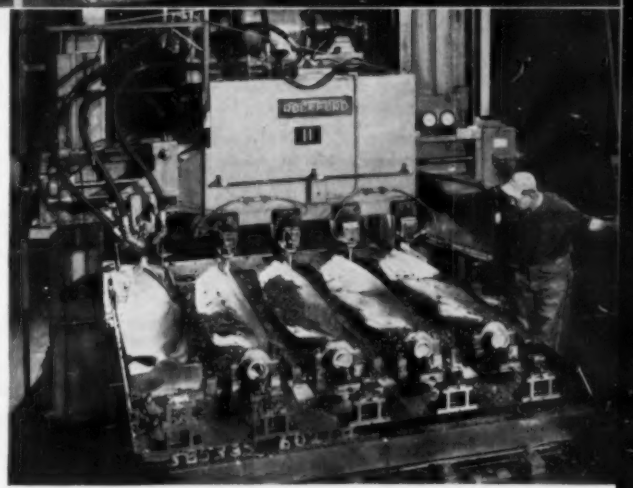

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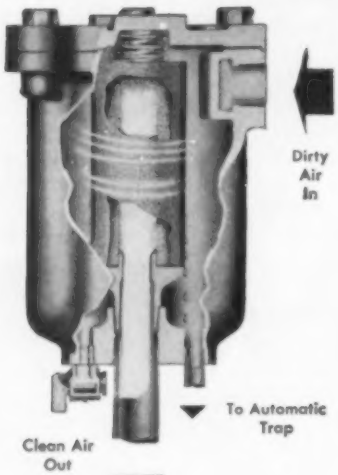

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SIMPLE HYDRAULIC CUSHION

Concluded from page 110

• **Operation**—To illustrate the operation and effect of the cushion, consider the machine table and actuator shown in Figure 2a. Here a cylinder with a 4-in. bore and a 1.4-in. diam rod is driving a table and load with a combined weight of 10,000 lb. Pressure is 500 psi and table speed is 120 fpm. If the stopping distance were ½ in., a pressure surge of 2500 psi would be created at the ram end of the cylinder and in the circuit to the control valve as the table was stopped and reversed.

With the buffer and valve in parallel with the actuator, Figure 2b, stopping time can be adjusted by adjusting the throttle, and stopping distance can be set with the adjusting screw to give any desired degree of deceleration. Actual sequence of events during stopping of the actuator is illustrated by Figure 3.

When this buffer was incorporated in the large surface grinder, the machine operated very smoothly at 90 fpm. There was no detectable shock or vibration and it was not necessary to fasten the machine to the floor. ▼▼▼

TEXAS TOWERS

Concluded from page 107

about ⅜-in. in diameter and 5-in. long for controlling the various electrical switches is mounted. This lever can be moved to seven different positions to actuate the required valves. One man controls the entire operation from this point.

A 20 gallon accumulator is used for each corner of the tower to insure fast operation of the clamp cylinders. Accumulators are also a safety feature to permit operation of the clamps if the main source of power should fail during operation.

SYNCHRONIZATION

Simultaneous operation of all control valves for a particular operation from a single point assures simultaneous actuation of valves and cylinders. Additionally, fixed-orifice, pressure-compensated, flow-control valves were used in the line to all cylinders to insure equal flow rates. Separate flow-control valves are used for each flow direction. As a precaution in the event a corner should lead or lag despite these provisions, an electrical plug at each corner permits freezing of the control panel at the corner to lock all the cylinders until the platform is levelled by raising the others.

An additional point worth mentioning is that cylinders at a corner tend to be self-equalizing. This is because any tendency by one cylinder to lead the others would cause it to pick up a higher portion of the load than the others. Since the higher load would increase the resistance to flow of that cylinder, flow to that cylinder would be reduced until the remaining cylinders picked up their share of the load. ▼▼▼

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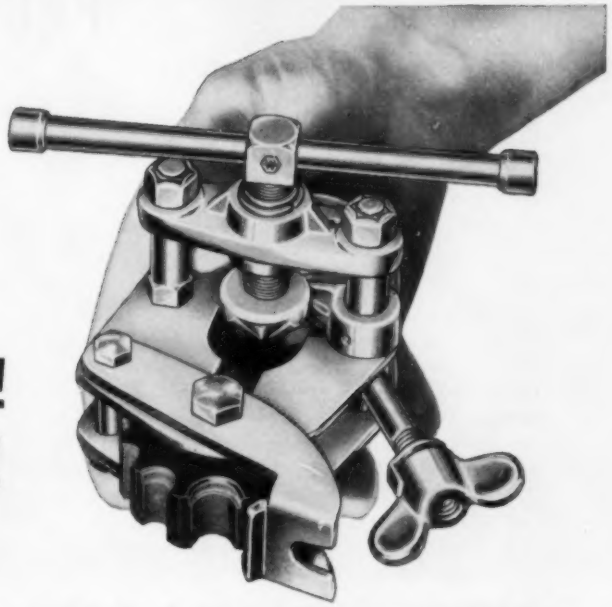

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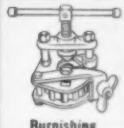
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ACCUMULATOR BLADDER with entire bottom cut off had no effect on the reliability of the accumulator for circuit breaker service. Actually, the unit became a non-separator type.

An accumulator is the power source on an electrical circuit breaker built by Allis-Chalmers. Reliability is a must. If an accumulator bladder fails, what happens? Here's how A-C engineers checked equipment performance.

ACCUMULATOR TEST PROCEDURE

. . . to evaluate reliability

ALTHOUGH bladder failure has never been a problem with their accumulators, Allis-Chalmers Mfg. Co. wanted to know the possible effects of a ruptured bladder on performance in this type of service. Tests were planned to find the answers to two questions important to both customer and manufacturer:

1. Will the accumulator function properly if the bladder is ruptured?
2. What changes, if any, would result in operating characteristics?

• **Procedure**—Three tests were made with different amounts of rupture present each time. The bladder was inserted into the accumulator and precharged with nitrogen to 1500 psi. The accumulator was then charged with oil to 2500 psi, and a series of 25 individual operations was conducted. Pressure was recorded three minutes after each operation. Oil level was checked at maximum pressure and also three minutes after operation.

For the first test, a $\frac{1}{8}$-in. hole was punched in the bladder seam. In the second, the bladder was slit for four inches along the seam. The lower portion of the bladder was completely removed for the third test.

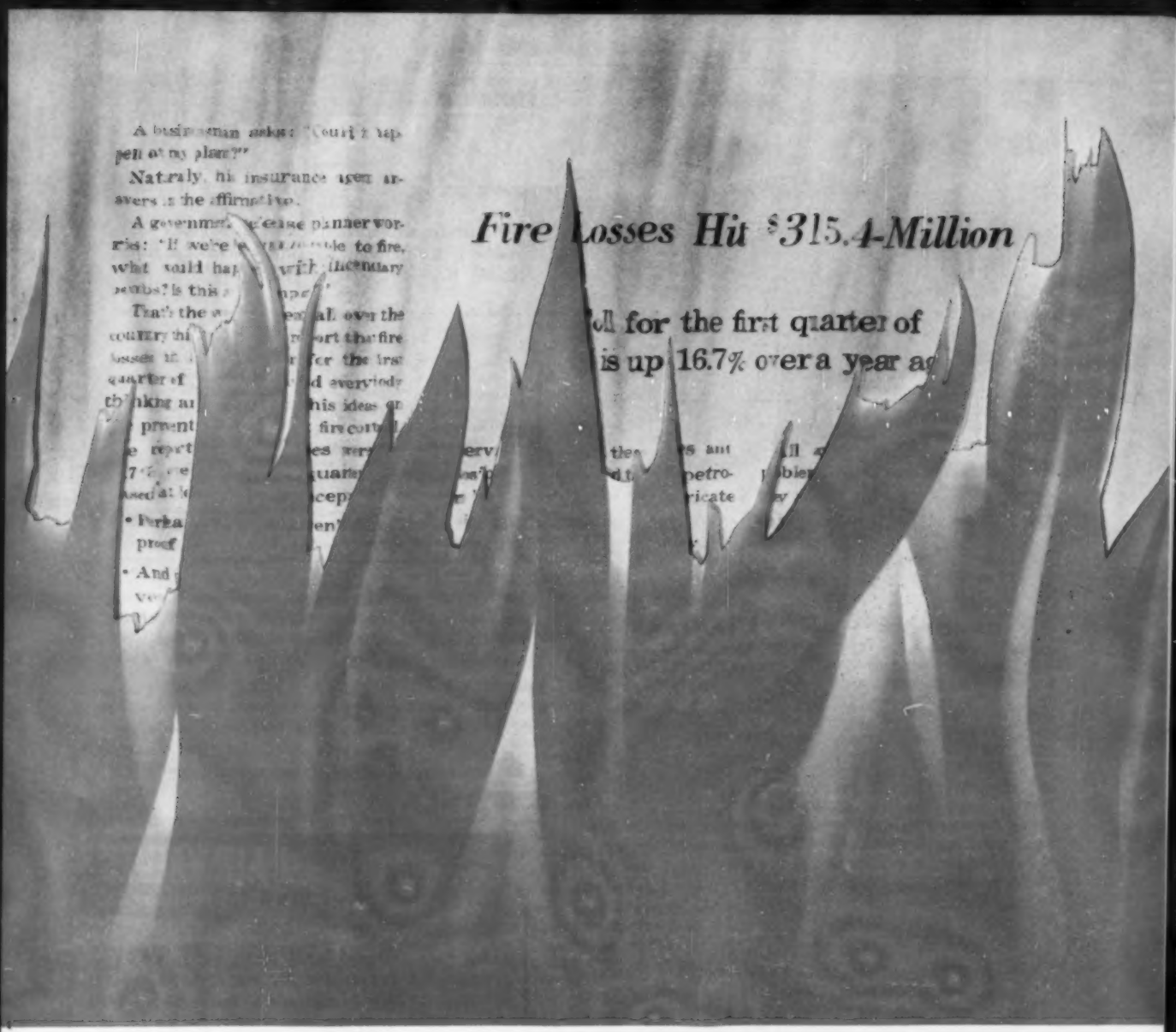
• **Results**—The tests proved conclusively that damage to the accumulator bladder has no discernible effect upon operating characteristics for oil-powered circuit breakers. Accumulator pressure three minutes after each operation was identical to pressure after normal breaker operation. There was no effect on the level of oil in the reservoir.

The bladder merely separates the precharge gas from the oil. Should a bladder fail in this circuit

WHY HYDRAULIC POWER IS USED TO CLOSE CIRCUIT BREAKERS

Closing large power circuit breakers cannot safely be done by hand due to the large force required. Before a circuit breaker is completely closed, an arc strikes across the contacts. Because of the large amount of energy released by this arc, once the closing operation is begun, the full stroke must be completed without hesitation.

The closing device is usually portable, and consists of a hydraulic hand pump with a built-in reservoir, and a bladder-type accumulator with a poppet valve arrangement in the oil port. The operator charges the system and then actuates the triggering valve, permitting the cylinder to quickly and smoothly close the circuit.



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Cellulube fire-resistant hydraulic fluids and synthetic lubricants are good examples. In hydraulic equipment, they reduce the danger of uncontrollable fire caused by line breaks or other failures when flammable fluids are in use. In air compressors, these non-petroleum oils not only prevent excessive carbon formations—the main source of fire and violent explosion—but also meet the severest of lubrication requirements.

Minimizing the hazards of industrial operations through development of fire-resistant Cellulubes . . . making these functional fluids available in 6 controlled viscosities for broader application . . . this is another example of Celanese research and product development at work hand-in-hand with industry.

Celanese Corporation of America, Chemical Division, Dept. **588-S**, 180 Madison Avenue, New York 16.

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Basic reasons . . . . for improved products

Acids	Functional Fluids	Polyols
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Aldehydes	Glycols	Salts
Anhydrides	Ketones	Solvents
Esters	Oxides	Vinyl Monomers

Celanese CHEMICALS

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Aviation	Plastics
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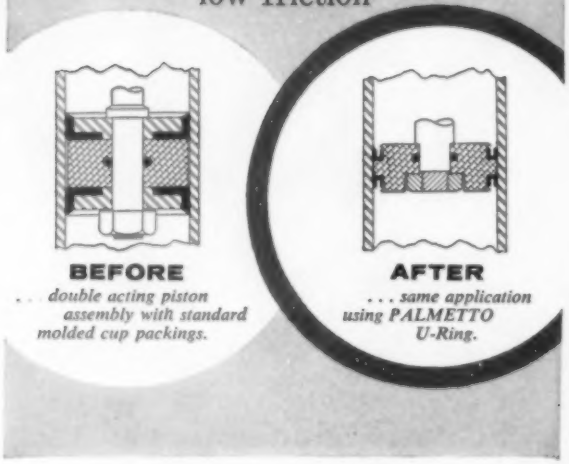
Redesign
with
PALMETTO® U-RING
for
low cost
and
low friction



BEFORE
. . . double acting piston assembly with standard molded cup packings.

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Engineers designing hydraulic and pneumatic cylinders are finding that PALMETTO U-Rings permit the use of low-cost, one-piece pistons in place of expensive, multi-part designs, with no sacrifice of efficiency. In fact, the one-piece piston with PALMETTO U-Rings is superior because it cannot loosen up, is easily assembled and serviced, and saves weight and space.

PALMETTO U-Rings seal with extremely low friction because they float freely in the packing groove. There is no opportunity for binding due to overcompression. Synthetic and fabric reinforced compositions in similar sizes allow interchangeability for high or low pressure service. The PALMETTO U-Ring is doing an exceptional job in the hydraulic equipment of many well-known manufacturers. Ask us how it can be used in your piston design to cut costs.

Rugged rectangular design PALMETTO U-Rings increases stability and eliminates rolling in the groove. Wide-lipped flare makes it suitable for use in cylinders made from commercial tubing honed up to .030 over nominal sizes.

For information on other PALMETTO packings and how they can help you simplify your design, please write.

PALMETTO Packings

packing more performance into every application

GREENE, TWEED & CO.
NORTH WALES, PENNSYLVANIA

ACCUMULATOR TEST PROCEDURE

closing device, the accumulator would in effect become a non-separator type, but could still do the job.

● **Maintenance**—Actual testing outside the accumulator is the only positive way to detect a faulty bladder. However, bladder failure might be indicated by excessive leakage of precharge, or excessive foaming in the reservoir after oil is drained from the accumulator. This should not be confused with normal foaming during operation, or when pressure is bled through a bypass valve.

Yearly checking of the precharge pressure will indicate the condition of the bladder. This should be sufficient in this application, since gas absorption occurs so slowly that leakage will not affect operation. ▼▼▼

Turbulence and Foaming

For the circuit closing operation a high force is required for only a brief period of time, and operation is infrequent. The accumulator is charged slowly with a hand pump and very little turbulence is created.

However, these test results would probably not apply to other uses of bladder type accumulators where operation is in rapid cycles. These units are being charged and discharged rapidly, with resulting high turbulence. Under these conditions, a leak in the bladder might quickly result in faulty operation or complete failure.

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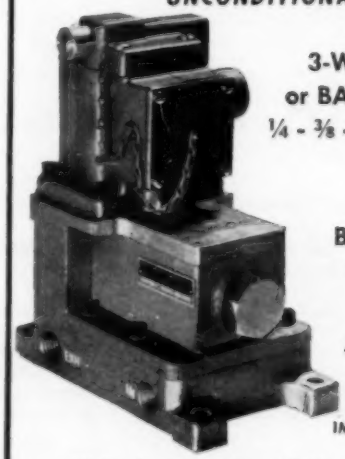

3-WAY IN-LINE
or BASE MOUNTED
¼ - ⅜ - ½ - ¾ - 1 - 1¼

● ● ● ●

4-WAY
BASE MOUNTED
¼ - ⅜ - ½ - ¾

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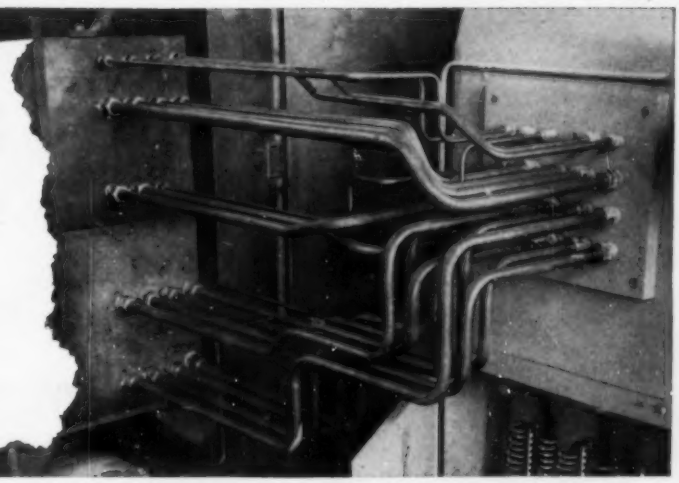
two-minute quiz for users of hydraulic line tubing



Q *Is there anything new in hydraulic tubing?*

A Yes, definitely. Republic is producing an electric welded steel hydraulic line tubing to a highly restrictive specification. This steel tube will assure unsurpassed performance in your high-pressure applications. It cannot contaminate hydraulic fluids. It is designated as Republic ELECTRUNITE® Hydraulic Line Tubing.

Q *What "highly restrictive specification"?*

A Designated as Specification HL-1, a copy is available to you by filling out the coupon below. It is designed to meet or exceed *all* requirements of hydraulic line materials produced by other methods. It is the result of knowledge gained in the manufacture of critical ammunition components produced for the Armed Forces. The excellent performance of this welded steel tubing proves its complete dependability beyond a doubt. The type of steel used to produce ELECTRUNITE has some effect on the service life of the resulting tube.

Q *What's different about this specification?*

A It calls for expansion over a plug until the outside diameter has been expanded 25%. When expanded, the required amount of expansion shall be performed throughout a minimum length of 1 inch along the axis of the tubing. This procedure is not only a good weld test, but also an excellent test for detection of any surface steel defects such as seams and laminations.

Q *Anything else?*

A Yes, the reverse flattening test assures complete penetration of the weld, and assures the user and producer that the proper procedure has been used in removing the I.D. weld flash.

Q *Why welded steel?*

A Republic pioneered the electric resistance welded method of producing highest quality steel tubing. In this process, the tube is cold-formed from flat-rolled steel. Both inside and outside surfaces can readily be checked for possible defects. After welding and normalizing, the tube is severely cold-worked after which it receives a final anneal. The resulting uniform tube wall, coupled with its high ductility, provides excellent flaring and bending characteristics. And, the tube is not subject to longitudinal or transverse cracks. It has uniform mechanical properties; it is free of seams and has uniform cross-section.

Q *What about fittings?*

A Republic Steel Hydraulic Line Tubing fits all standard fittings and accessories.

Q *How about sizes?*

A This high-performance tube is readily available in a wide range of sizes, ⅜-inch through 2½-inch, and in wall thicknesses regularly used in hydraulic applications.

Q *Why should I change?*

A Several reasons. Performance is one. This tube will assure unsurpassed performance in all types of applications. Uniform bends and uniform flares make it easy to install and reduce the possibility of vibration or stress failures. Economy is another reason. Republic Steel Hydraulic Line Tubing costs you less. And, it keeps on saving, through reduced maintenance costs.

Q *Where do I buy it?*

A Distributor stocks are now going in. If your distributor is not stocked up yet, write Republic. We'll gladly supply a test sample and full information. And, we'll work with your distributor to get him set to supply your requirements.

Q *How do I get a test sample?*

A Send coupon.

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STEEL AND TUBES DIVISION

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I'm interested. Please forward me a test sample of Republic Steel Hydraulic Line Tubing.

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FLUID MOTORS

. . . on

Perhaps the best known characteristic of the hydrostatic transmission is smooth, stepless speed change. However, it can offer many other benefits. Here's an instance where variable speed was not a requirement, a hydraulic drive reduces the number of mechanical components, overhung weight, operator fatigue, vibration and horsepower requirement.

ORIGINAL version of a weed mower made by Fairmont Railway Motors Inc. for keeping railroad rights of way clear of unwanted vegetation used two, single-cylinder, air-cooled gasoline engines to power the sickles. Engines were mounted near the ends of supporting beams to keep the mechanical power transmission system reasonably simple. Net result was quite a bit of overhung weight. Bevel gear sets and V-belt drives were necessary between engines and sickles. Raising and lowering sickles to adjust the height of cut and tilting were hydraulic. But manual pumps were used since a third engine would have been required to drive a pump for these intermittent operations.

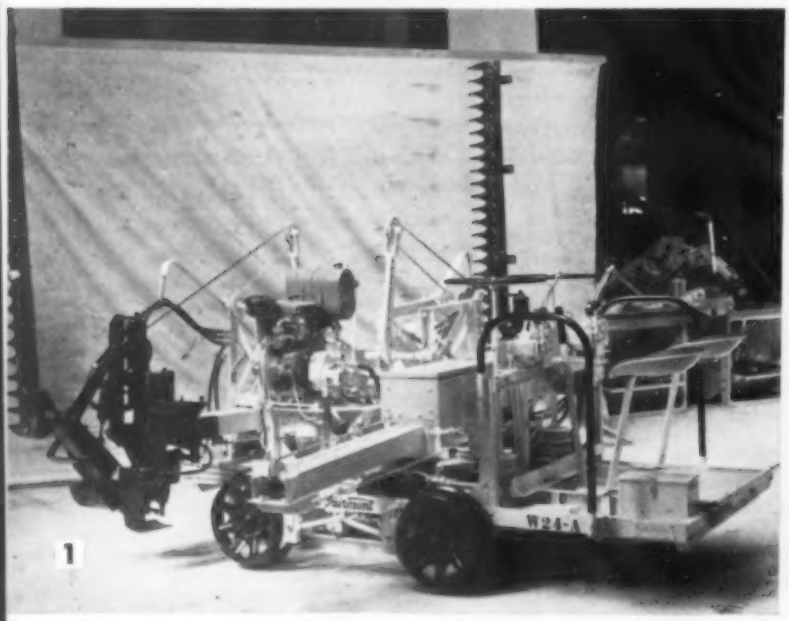
Redesigned version of the machine, Figure 1, uses one 8.25-hp engine, only slightly larger than one of the original two, to drive two hydraulic pumps. Pumps and engine are mounted in the center of the weed mower. Pump output is used to drive the sickle bars, and raise, lower and tilt the sickles.

Sickle drive is by hydraulic motor mounted at the outboard ends of the sickle support beams, Figure 2. Motors drive the sickle bars directly through

Fig. 1. Use of hydrostatic power transmissions on this weed mower results in many improvements over the previous model. Sickle bars are shown here in a vertical position.

Fig. 2. Hydraulic motors for driving sickle bars are mounted at outboard ends of the sickle support beams. Simplicity of power transmission through pipes, tubes or hoses is an extremely valuable feature of hydraulics in this application.

Fig. 3. Circuit diagram of the hydraulic system on Fairmont Railway's weed mower.

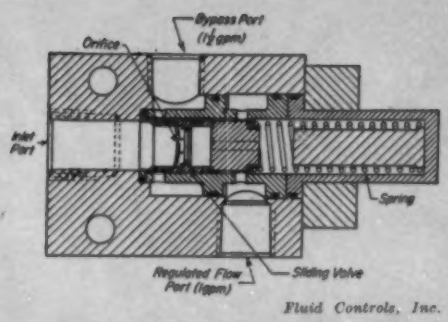


DRIVE CUTTERS

a weed mower

flexible couplings and the cranks and pitman arms necessary to obtain sickle reciprocation. Maximum torque of the hydraulic motor is 27 lb-ft at the maximum operating pressure of 1800 psi. Another advantage of the hydraulic transmission in this instance is reversibility obtained at little cost by using three-position, four-way valves to control the motors. This makes it possible to clear the sickle bar should it become clogged by extremely heavy vegetation. Previously, clearing a clogged bar was performed by the operator after he stopped the machine and got off.

Exhaust oil from the hydraulic motors is used to operate the sickle lift and tilt cylinders, Figure 3. In the development model full motor output volume was used. However, this produced such fast action that some way to slow these cylinders down was necessary. A three-port, pressure-compensated flow control valve provided the answer. Cylinder operation at the required rate takes 1 gpm. The other 1½ gpm is returned to tank by the flow control. Bank-type poppet valves are used to control the tilt and lift cylinders because they permit no leakage and hold the cylinders in the required position. ▼▼▼



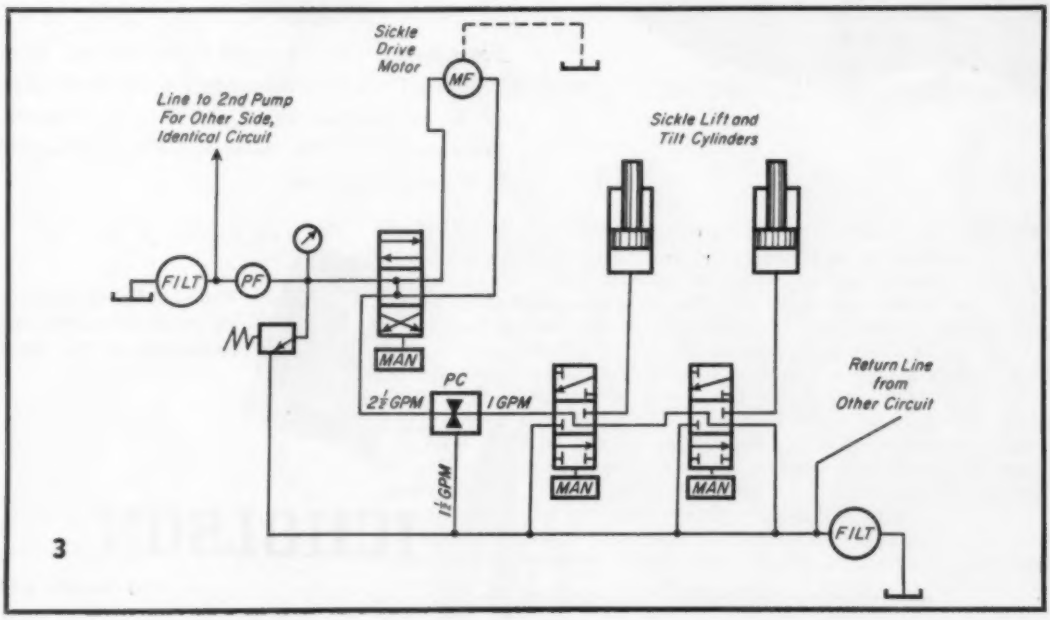
Fluid Controls, Inc.

HOW THE THREE-PORT FLOW-CONTROL VALVE WORKS

To prevent "too fast" action of the sickle lift and tilt cylinders on the weed mower, flow from the hydraulic motors had to be reduced. A three-port, pressure-compensated flow-control valve was the answer.

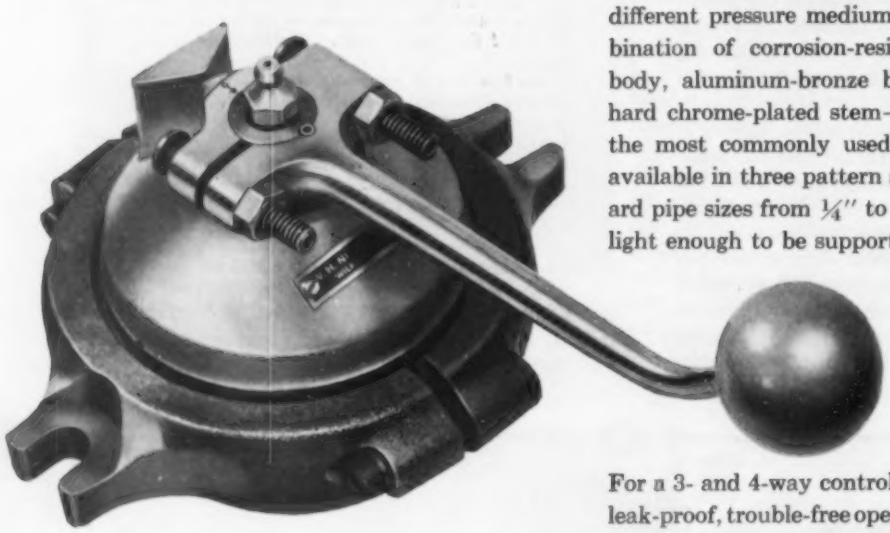
Oil passing through the orifice in the sliding valve creates a pressure differential that pushes the valve back against the spring. Since the spring exerts essentially a constant force, the pressure differential is constant and the flow to create the differential is constant.

If the flow through the orifice tends to increase, the pressure differential is increased and the valve moves to uncover the bypass ports. If, after uncovering the bypass ports, flow through the orifice still tends to increase, the sliding valve moves back further and throttles the outlet ports. Regulated flow rate is nonadjustable in this particular valve and is set at the factory.



Here's a control valve that assures you

leak-proof service



Highly-lapped metal-to-metal surfaces of this Nicholson control valve assure you leak-proof service. The O-ring stem packing and O-ring seal between the body and base make joints leak-proof without excessive bolt tension.

You can use the Model 300 with air, water, hydraulic fluid or oil as the pressure medium . . . at operating pressures to 300 psi. Use it to activate single- or double-acting cylinders. Simple and rugged, this valve provides accurate, repeatable control of equipment such as presses, hoists, clutches and chucks. Valve maintenance is no problem . . . all stem, base and disc bearing surfaces are lubricated through one easily accessible fitting on top of valve stem. Lubricant reservoir in base reduces frequency of lubrication.

No need to stock valves or parts for service with different pressure mediums. This valve's *one* combination of corrosion-resistant materials—bronze body, aluminum-bronze base, stainless-steel disc, hard chrome-plated stem—is well suited for all of the most commonly used pressure mediums. It's available in three pattern sizes covering five standard pipe sizes from ¼" to 1" . . . small enough and light enough to be supported by connected piping.

For a 3- and 4-way control valve that will give you leak-proof, trouble-free operation, specify Nicholson. W. H. NICHOLSON AND COMPANY, 14 OREGON ST., WILKES-BARRE, PA. Sales and Engineering Offices in 98 principal cities.

Write for Bulletin 300 . . . covering design, construction, sizes and applications for the Model 300

NICHOLSON

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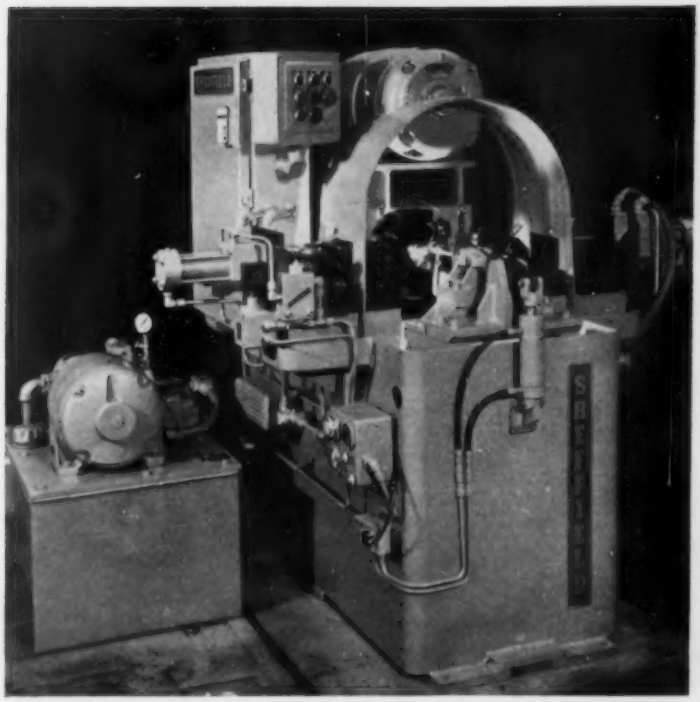
Rate of feed during thread rolling is very important, as material displaced by the rolls forms the OD of the part. Hydraulic actuation of the attachment slides provides both speed and precision.



HYDRAULIC-powered attachment slides permit accurate control of rate of penetration and rapid, maximum traversing. Clevis-mounted air cylinder at the tail stock provides force to clamp part firmly during thread rolling.

CRITICAL THREAD ROLLING FEED RATE

. . . accurately controlled by hydraulics

• By Ralph R. Holt

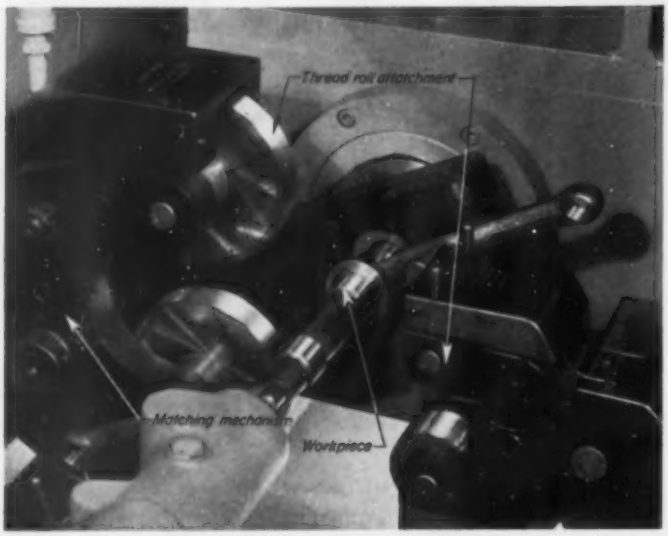
IN MODERN thread-rolling equipment, as designed by The Sheffield Corporation, threads are generated on the work piece by cold-working its periphery between two hardened and ground rolls. The rolls in this cold-forging operation have the desired thread form of the end product ground into their periphery. Pitch diameter of the work piece is obtained by closing the amount of space between the two rolls. Hydraulic controls help make possible the high degree of speed and precision achieved in this rapidly developing field.

Throughout the rolling cycle, the rolls are kept in precise match with each other by gearing them together in an attachment. Matching is accomplished through a simple adjustment made in the matching mechanism. This consists of a shaft which is linked to a gearing train to adjust the rotational relationship of the rolls.

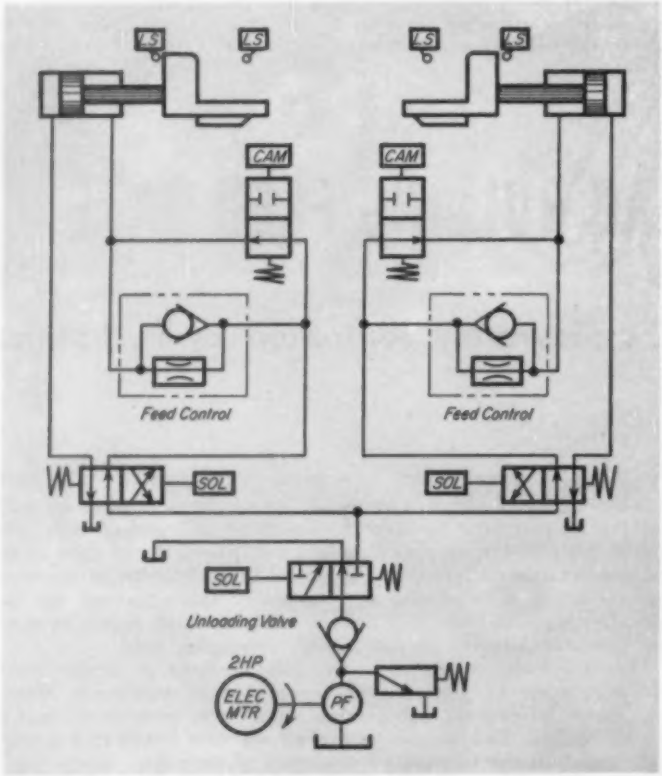
• **Thread Rolling**—The blank work piece is approximately the pitch diameter of the desired threads. The rolls are advanced forward until

RALPH R. HOLT, *Sales Engineer, The Sheffield Corp., Dayton, Ohio*

CRITICAL THREAD ROLLING FEED RATE



TWO ROLLING ATTACHMENTS are used, each on its separate slide, for rolling threads at two points on a shaft. Attachments are shown in retracted position.



FEED RATE is controlled by meter-out, flow control valves, after cam-operated valves close just before rolls contact the workpiece. Limit switches and timers control shifting of the solenoid valves.

they are directly over the center of the work, and then quickly retracted.

During this advancement, the rolls penetrate the blank causing the portion of its material that is squeezed up or displaced by the rolls to form the outside diameter of the finished part. The rate of feed during the penetration of the work piece by the rolls is very important. By using a hydraulic system to actuate the slide carrying the thread rolling attachment, the rate of penetration can be accurately controlled to any desired degree.

Because physical contours of some parts require facility and ease in loading and unloading, the two slides carrying the rolling attachements must be traversed a maximum amount. Again, the hydraulic system for rapidly actuating the slides is the answer.

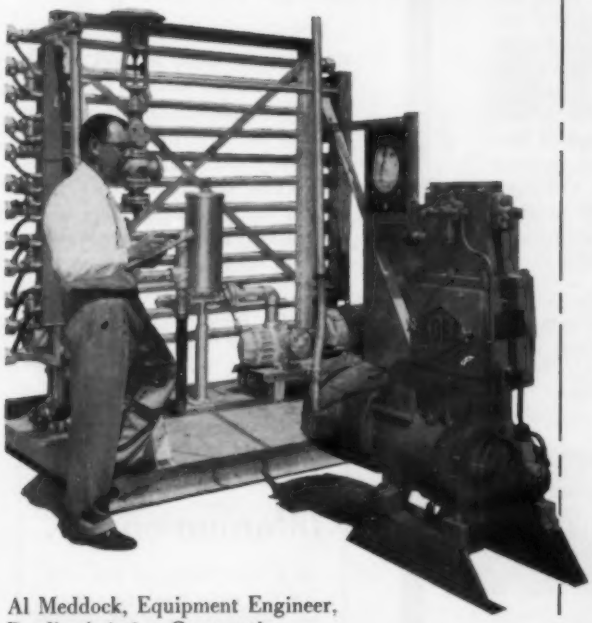
Hydraulic fluid goes through a metering valve which is set to permit the rolls to penetrate the work piece. Thus hydraulic actuation controls the proper rate to produce parts within specified tolerances, and to secure maximum roll life.

• **Hydraulic design data**—An adjustable thread rolling attachment of 3700 lbs push is required. To develop this force a 2.5 gpm vane pump capable of 2000 psi operation was selected. Feed cylinder bore is 2 in. Feed rate is adjustable from .001 in/rev. to .050 in/rev by use of the meter-out flow control valves which are pressure compensated, adjustable controls.

• **Sequence**—When the hydraulic start button is depressed, fluid is pumped through the unloading valve and back to tank under zero pressure, minimizing heat generation in the system. Both slides are in the retracted position contacting limit switches. A part having an area to be thread rolled is placed between the centers in the machine. Air pressure against the center holds the part firmly.

The cycle start button is depressed starting the spindle motor

The KOBE TRIPLEX PUMP handles extreme temperatures on hydraulic test stand for Bendix



Al Meddock, Equipment Engineer, Bendix Aviation Corporation, checks a high temperature run on hydraulic teststand equipped with a KOBE Triplex Pump. He says—"In our experience the Kobe Triplex is the only pump that will do this job."

The high-temperature test facility at Bendix-Pacific Division, North Hollywood, California, includes a Kobe Triplex Pump which is currently testing supersonic aircraft and missile components at 500°F at pressures up to 5,000 psi. These tests have been so successful that plans are being laid to go to 800°F in the near future. According to Al Meddock, Bendix engineer in charge of these flight simulation tests, "The Kobe Triplex Pump is superior to any known industrial equipment at these temperatures."

The Triplex is a heavy duty, plunger pump capable of long, unattended service. It is independently lubricated and requires no cooling device of any kind. Crankcase temperature has never exceeded 180°F even under prolonged operation. Closely fitted metal-to-metal plungers and liners eliminate need for packing and seals, and can be easily interchanged to attain flows up to 35 g.p.m. and pressures up to 5,000 psi. Reduction gearing is built-in with choice of six ratios. Pumps are available with an integral motor or with an external drive shaft.

The Kobe Triplex has been manufactured for over 25 years serving many types of industry. It is currently serving in applications requiring high pressure duty—operating hydraulic presses and molding equipment, testing hydraulic accessories, impulse surge tests, checking welded pipe and pressure vessels, raising oil hydraulically from deep underground sources. Now with the recent advent of faster flying speeds, greater altitudes and longer range ballistic missiles, temperature has become a vital factor. With slight modifications the Kobe Triplex can be adapted for extreme temperatures as well as for pressures. For complete information on the Bendix and similar installations, write or call Kobe, Inc.

Triplex Features:

Temperatures—above 500°F
Pressures—to 5,000 psi (standard)
to 10,000 psi (special)
Integral double reduction gears
Integral electric drive (optional)
Power ratings—to 60 HP
Volumes—to 50 g.p.m.
Built-in lubrication
Ball type valves
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CRITICAL THREAD ROLLING FEED RATE

and shifting the unloading valve and four-way valve 1. Hydraulic pressure goes into the blank end of cylinder 1, starting left hand slide forward with hydraulic fluid going from the rod end of the cylinder, the cam-operated valve and valve 1 back to tank. When the cam valve closes, just before the rolls contact the work piece, fluid must go through the feed control valve.

At the end of the forward stroke, a limit switch is contacted and through a timer, valve 1 is deenergized. Fluid now goes to the rod end of cylinder 1 and left hand slide is rapidly retracted. When this slide contacts a limit switch, valve 2 is energized. Hydraulic pressure is now applied to the blank end of cylinder 2, starting the right hand slide foward.

When the end of this forward stroke is reached, a limit switch is contacted and through the timer, valve 2 is shifted. Fluid goes to the rod end of cylinder 2, rapidly retracting the right hand slide. When this slide contacts a limit switch, the unloading valve is deenergized, allowing hydraulic fluid to once again dump to tank under zero pressure. At this same time, the spindle motor is stopped, allowing the operator to unload and load the machine. ▼▼▼

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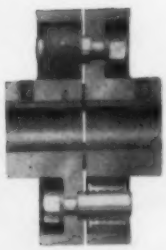

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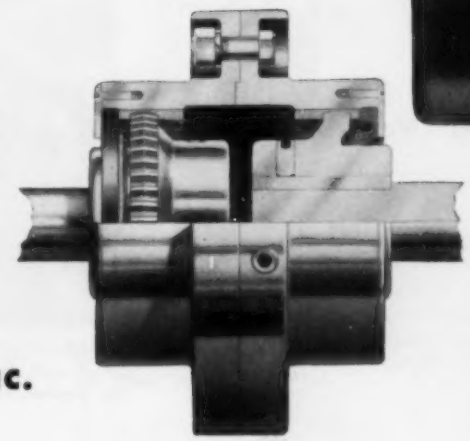

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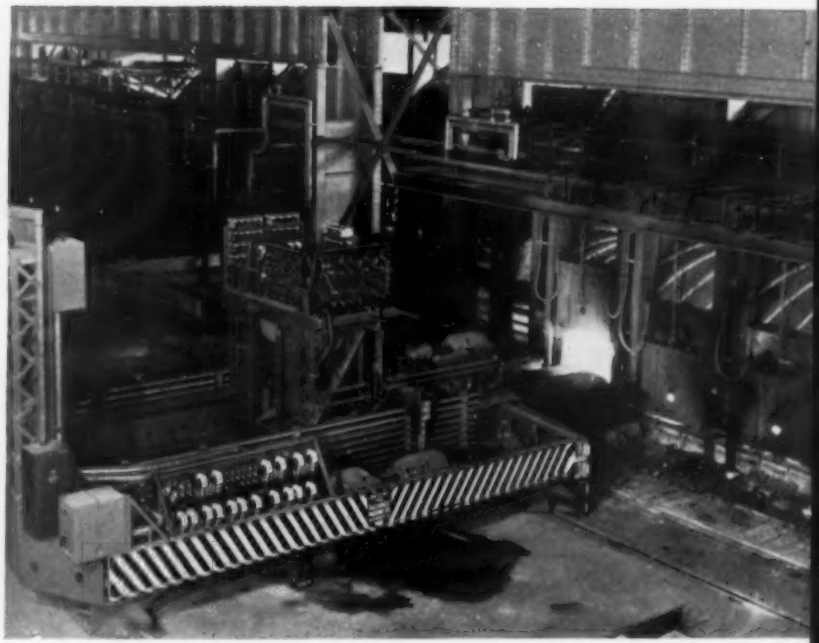
REMOTE SERVO CONTROL OF A 4-WAY VALVE

. . . through

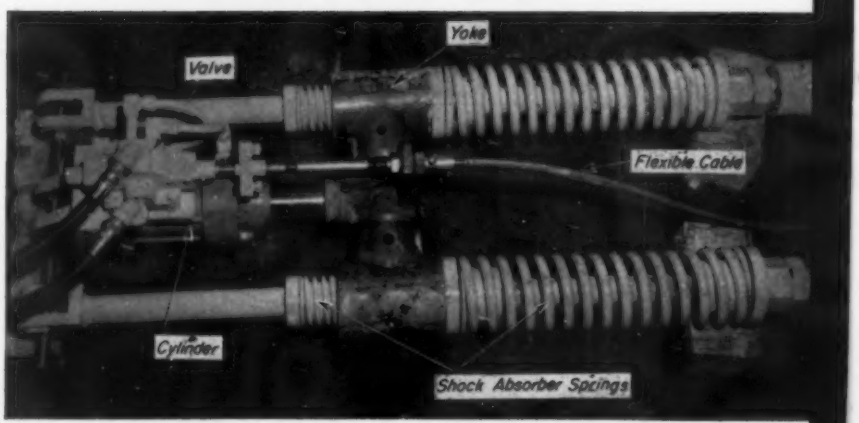
How would you actuate a control valve located away from the operator's position? The directional control valve is mounted on the cylinder which actuates a lock rod on this charging machine. Servo control of the valve from the operator's cage is done with a flexible cable.



PROPER CHARGING OF THESE STEEL OPEN HEARTHS DEPENDS ON THIS SIMPLE HYDRAULIC DEVICE

● By E. L. Elliott and Bill Morris

E. L. ELLIOTT, *Alliance Machine Co. Alliance, Ohio,*
BILL MORRIS, *S. G. Morris Co., Cleveland, Ohio*



OPEN-HEARTH CHARGING machine services a bank of furnaces in a steel mill. Servo action of valve mounted on cylinder permits operator to control each position of lock rod.

flexible cable

CHARGING an open-hearth furnace in a steel mill is a job requiring remote controls to protect the operator from heat. Locking the peel head to the charging box and later releasing it has been a difficult manual operation requiring levers and linkages. The Alliance Machine Co. has developed a method similar to power steering for hydraulically operating the lock rod. This device has been successfully applied to many charging machines.

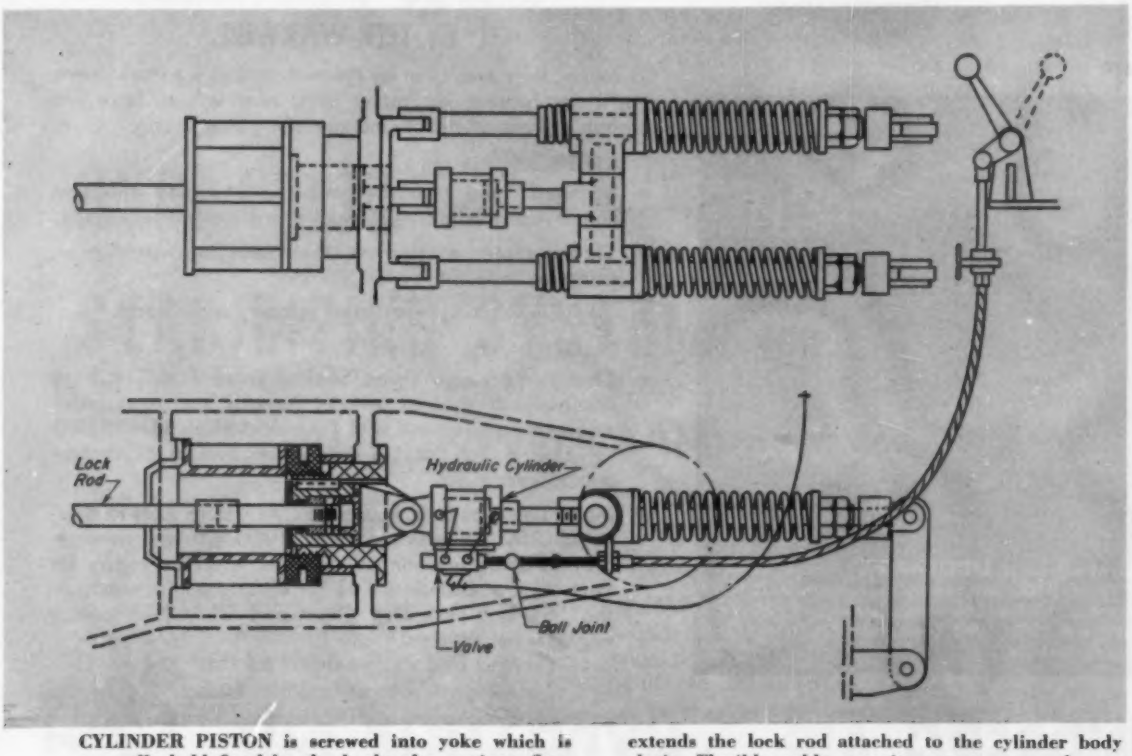
LOCK ROD OPERATION

The operation of this hydraulic lock rod is explained by referring to the illustration. The lock rod is connected to the head end of a hydraulic cylinder. The cylinder rod is connected to the charging peel frame through a yoke restrained by springs. The cylinder and actuating 4-way valve are attached to a common base. The valve is operated by a push-pull cable controlled by a hand lever mounted in the operator's cab. Hydraulic pressure is applied to the valve through flexible hose from the hydraulic power unit mounted on the trolley frame. The power unit, a vane type pump mounted on a 20-gallon reservoir, is driven by a 2-hp constant speed motor.

To move the lock rod forward to lock the peel head to the charging box, the operating handle is moved slightly forward opening a valve port to the head end of the cylinder. This moves the cylinder body forward away from the piston which is held fixed. If the handle is stopped, the cylinder and valve move forward only far enough to close the valve port, and motion then stops because of the servo action of the valve mounted with the cylinder. For the full stroke of the rod, the handle must continue its forward motion until the stroke is completed. Thus the operator *feels* the entire locking stroke and the hydraulic power unit does the work.

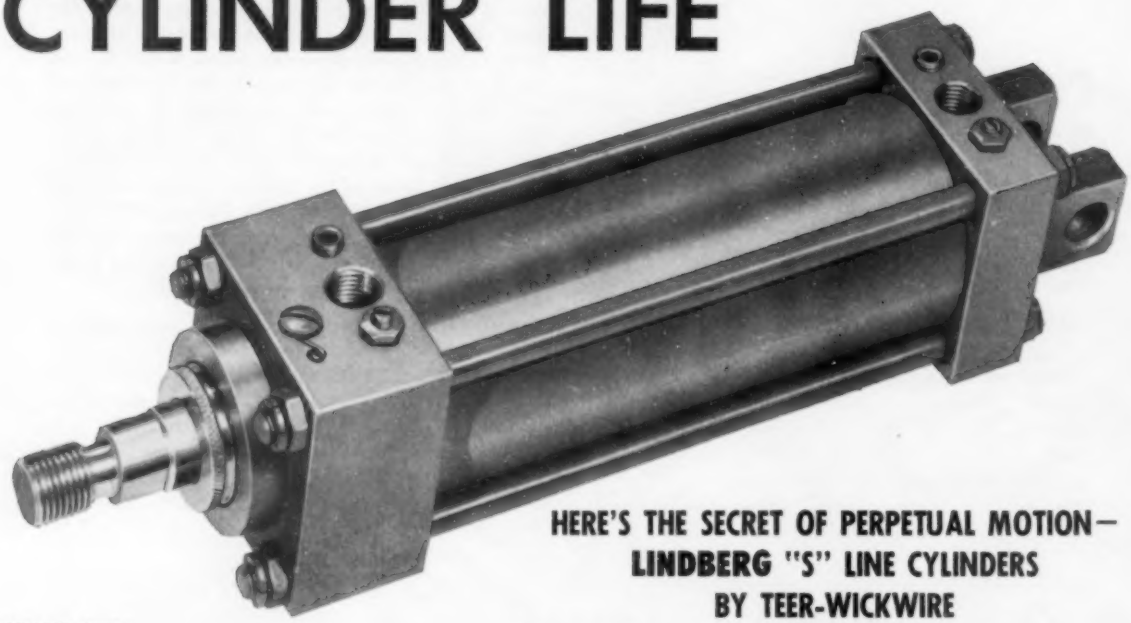
SHOCK ABSORBER ACTION

Springs which restrain the sliding yoke holding the rod of the cylinder act as shock absorbers if the lock rod should foul against the box instead of entering the hole, or if it encounters some other obstruction. Because cylinder movement is prevented, the piston pushes back against the yoke and compresses the springs. When the lock rod is free, the springs recoil and move the assembly, including the cylinder rod, forward. ▼▼▼



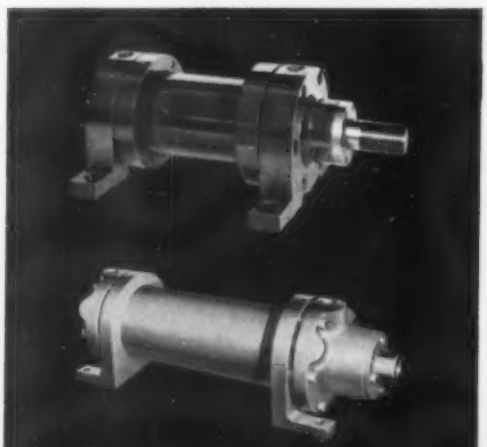
CYLINDER PISTON is screwed into yoke which is normally held fixed by shock absorber springs. Supplying pressure oil to the head end of the cylinder extends the lock rod attached to the cylinder body clevis. Flexible cable permits remote manual control of the 4-way valve.

BUILT OF STEEL FOR LONGER CYLINDER LIFE



HERE'S THE SECRET OF PERPETUAL MOTION— LINDBERG "S" LINE CYLINDERS BY TEER-WICKWIRE

MEMBER NFPA



Ask about other **LINDBERG** Cylinders: Top—"H" Line, 2000 psi hydraulic (Bulletin H-101) • Bottom—"A" Line, air or low pressure hydraulic (Bulletin A-101) • Mill Type and other specials—write for details.

Of course, they won't run by themselves and we can't prove they'll run forever but many units, now in use, *have* run through millions of cycles and are still going strong.

HERE'S WHY!!

- Seamless Tube is hard chrome plated and precision honed mirror bright—practically scratchproof—closer fit.
- Chrome plated manganese steel Piston Rod—stronger—abrasion resistant.
- Steel Tie Rods—pre-stressed to carry equal load.

PLUS

- Change Packing, Wiper, Seal or Entire Rod Cartridge Assembly in minutes without special tools—exclusive quick change feature with Teer-Wickwire's **LINDBERG** "S" Line • Full floating cushions • Built to JIC recommendations.
- Mounting styles to fit your needs • 7 bore sizes to 6"—rated 250 psi pneumatic, to 1000 psi hydraulic • Standardized mounting dimensions • Write today for your copy of Bulletin S-101 for complete information on the "S" Line including these and 23 other soundly engineered features.

LINDBERG AIR and HYDRAULIC DIV.

TEER-WICKWIRE & CO. • 1802 WILDWOOD AVE., JACKSON, MICHIGAN

Circle 145 on Reader Service Card

HYDRAULIC CONTROL positions these 14-ton, 7 x 14 ft stabilizer fins at 27 degrees per second, with maximum accelerations of 150 degrees per second, per second. Flap hinged to trailing edge adds extra lift.

How It Works . . .

When the sea acts upon the ship to produce roll, sensing elements in a control console measure the developing roll. Outputs of the sensing elements, combined in an amplifier computer unit, are a measure of the fin lift needed to resist roll. In response to this computation, hydraulic servos begin to position each of the fins. A lift sensor in each fin measures the actual lift developed and causes the hydraulics to adjust fin angle to obtain the exact computed lift. Lifting force developed in each fin is the exact amount needed to counter the impending roll.

• By R. N. Cronemeyer

HYDRAULIC STABILIZING SYSTEM

. . . gives smooth sailing in rough seas

On large ships, king-sized stabilizer fins are used to prevent rolling due to wave action. These fins must be tilted swiftly and precisely while being subjected to tremendous forces caused by their lifting action and the ship's speed. To do this job, engineers at Sperry Gyroscope developed an electro-hydraulic-mechanical servo system.

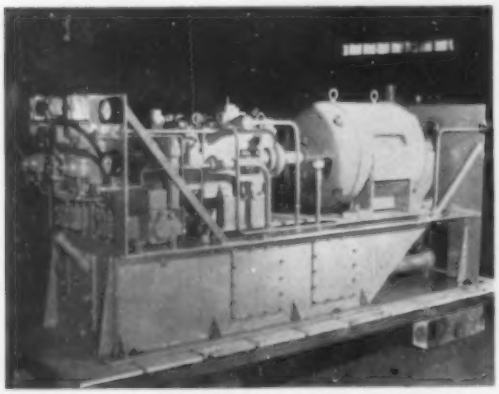
STABILIZER fins are installed, one on each side of the vessel. When the ship starts to roll to one side, the fin on that side is tilted upward creating a lift. At the same time, the opposite fin is tilted down, creating a pull downward to oppose the rolling action.

R. N. CRONEMEYER, *Senior Engineer, Marine Div., Sperry Gyroscope Co., Great Neck, N. Y.*

HYDRAULIC STABILIZING SYSTEM

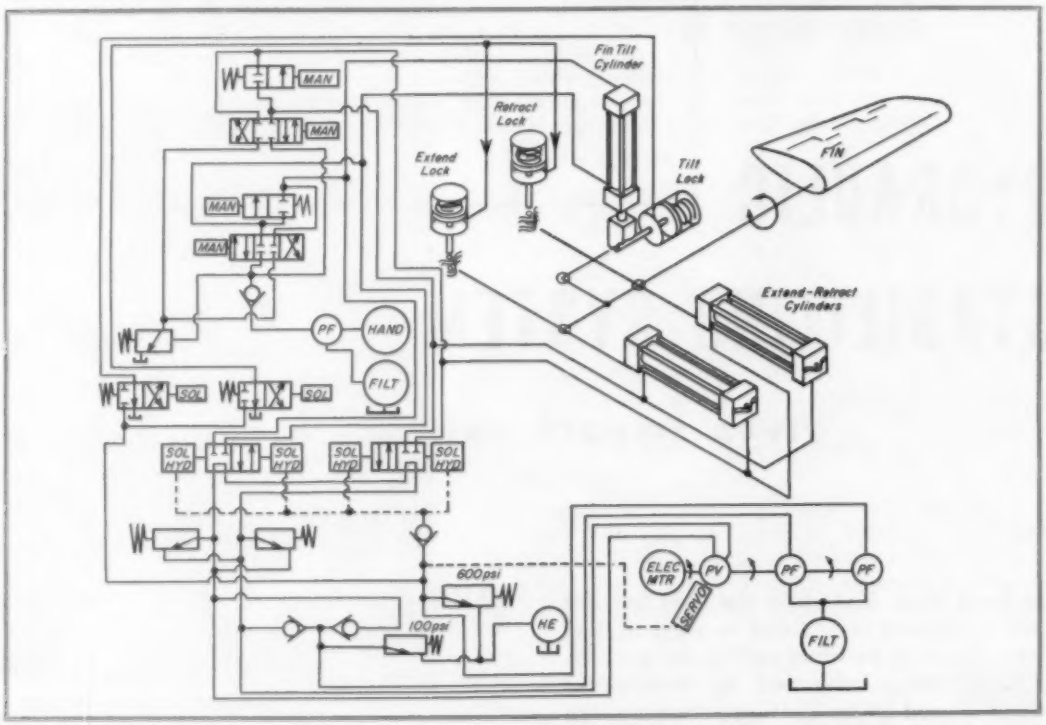
• **Pump assembly**—Hydraulic pump assembly consists of an electric drive motor coupled to a variable-delivery, reversible pump, and associated valves, auxiliary pumps, filters, heat exchanger, etc. One of the two tandem mounted auxiliary pumps supplies replenishing oil to the system through a conventional check valve arrangement. The other unit supplies oil to a rotary booster valve used to stroke the main pump, and also supplies oil to cylinder-actuated locks through two solenoid-operated valves. The discharge from the two balanced relief valves, which control the pressures for replenishing and booster systems, is directed through a salt water heat exchanger before returning to sump. Cooling water flow is regulated to maintain an average oil temperature of about 140 F.

• **Servo valve**—The booster or servo valve used to stroke the main pump is of particular interest. The valve itself consists of a rotary, differential-



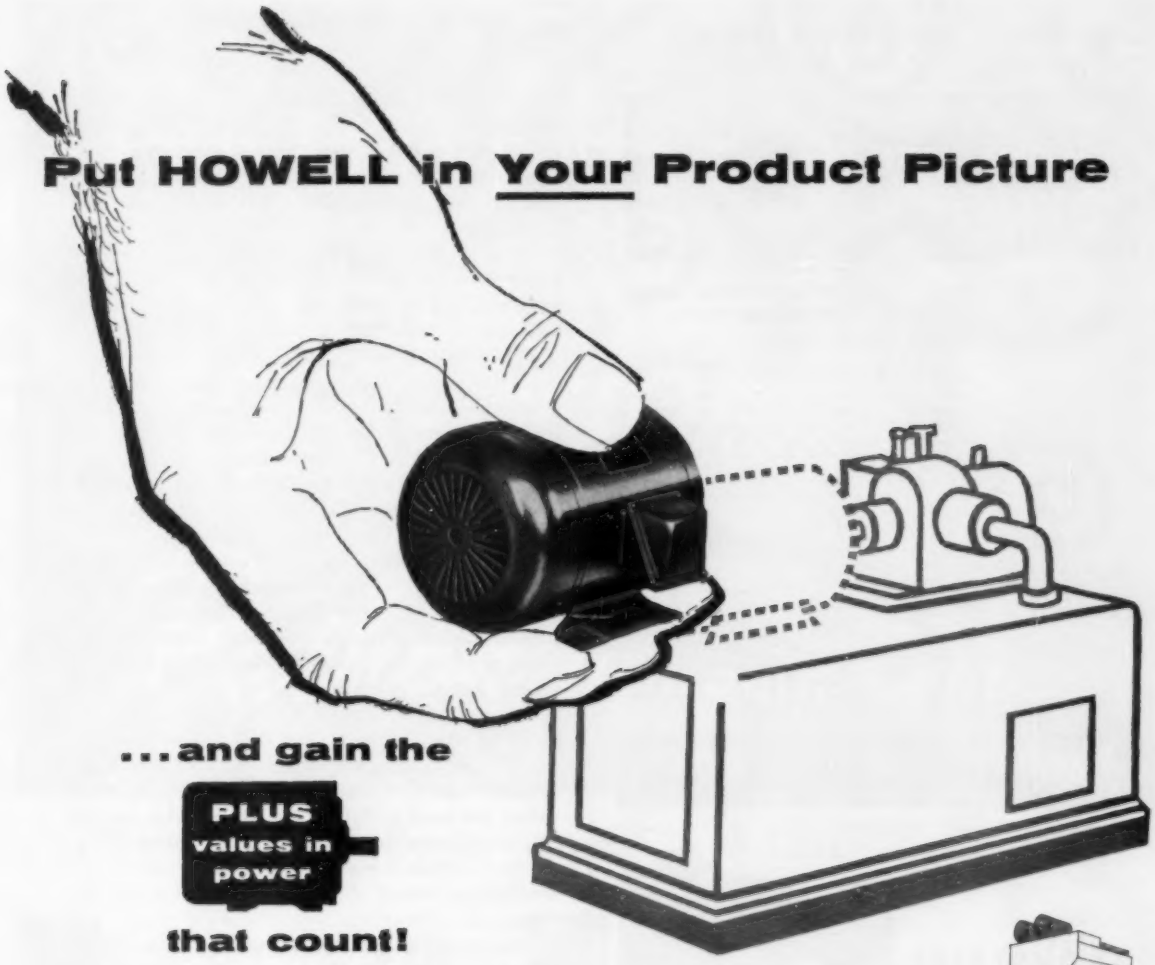
HYDRAULIC PUMP ASSEMBLY showing 75 hp electric drive motor, 110 gpm variable-delivery, main pump, valve panel, heat exchanger and tank.

VALVE PANEL contains both manual and solenoid-operated valves. Rigging ram is shown at lower left with tilt and rig piping in front center.



TWO LARGE SOLENOID-OPERATED VALVES direct flow from main pump to two separate systems, one powering the rigging cylinders and the other the tilting cylinders. Manual pump secures the fin in case of power failure.

Put HOWELL in Your Product Picture



...and gain the

PLUS values in power

that count!

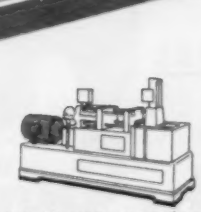
No matter how efficiently designed your hydraulic equipment may be, in operation its dependability rests . . . year in and year out . . . on the motors you select to power it. That's why manufacturers and users of hydraulic machinery, from simple pumps to the largest presses, are specifying Howell motors in ever increasing numbers. Here are a few of the reasons:

EXTRA DEPENDABILITY that challenges the years. Howell's new principle of heat-source ventilation . . . double sealed bearings . . . tough rolled steel frames and precision fitted cast iron end plates . . . these and many more are plus values that *count!*

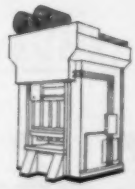
AN UNSURPASSED REPUTATION for engineering excellence and quality manufacture . . . built up by Howell in over 40 years of serving industry's motor requirements.

TOPS IN APPEARANCE. No other industrial motors have such smooth, unbroken contours . . . without an external fin or rib to mar their looks or catch dust deposits.

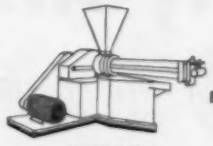
Howell makes virtually every type of AC industrial motors . . . fractional and integral to 300 hp, in all standard enclosures, in both rerated and non-rerated frame sizes, and in many pump mountings. Howell part winding motors, for economical reduced voltage starting of pumps may be of special interest to you.



DIE CASTING MACHINES

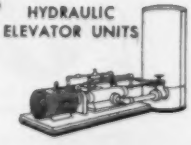


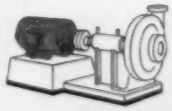
HYDRAULIC PRESSES



EXTRUDERS

HYDRAULIC ELEVATOR UNITS





FLUID TRANSMISSION PUMPS

Howell motors are specified and used by these leading manufacturers of hydraulic equipment:

The Denison Engineering Co. • Hydraulic Press Manufacturing Co. • Rotary Lift Co. • Globe Hoist Co. • Century Hydraulics, Inc. Haughton Elevator Co. • Michigan Drill Head Co.

A Howell sales engineer can give you valuable assistance on any motor application. Wire or 'phone collect . . . or drop us a line . . . you'll get prompt action. Howell Electric Motors Co., Howell, Michigan.

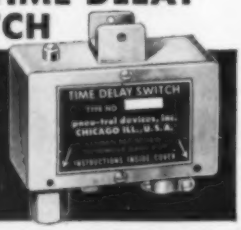
HOWELL *motors*

. . . precision built for industry since 1915

Circle 118 on Reader Service Card

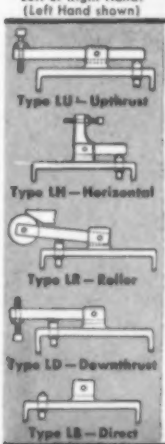
Pneu-Trol TIME DELAY CONTROL SWITCH

...Gives Cylinder Applications Greater Efficiency Accuracy ...Wider Use!



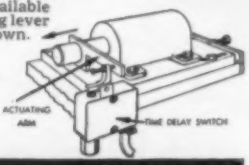
For any type actuation Left or Right Hand. (Left Hand shown)

- Holds Cylinder dwell accurately to fraction of second. • Automatically re-sets.
- Simple, Compact, Rugged.



You can hold any motion or operation controlled or actuated by air or hydraulic cylinders at a positive stop on either end of the stroke for ¼ to 60 seconds in 20 to 1 ratios with Pneu-Trol Time Delay Control Switches. Simple in design with positive hydraulic timing action . . . compact and easily mounted on the machine or fixture, Pneu-Trol Switches are providing millions of trouble-free actuations in solenoid-operated cylinder applications of every type. Positive, controlled time dwell permits wider use of air or hydraulic power in automatic operations, increases accuracy of work by insuring split-second accuracy of the dwell. Available with 5 actuating lever linkages as shown.

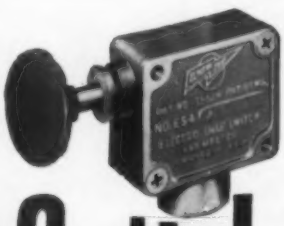
Switch mounted to provide dwell at end of power stroke of single action, spring return cylinder.



Pneu-Trol DEVICES, INC.

1426 N. KEATING AVENUE • CHICAGO 51, ILL.

INDUSTRIAL



Safety Switch

ELECTRO SNAP TYPE ES4-J

ES4-J $9.80
ES4-JM2 (Momentary) $10.80

Ideal for two hand safety on punch press

Designed for safety, stop and start, or interlock use. Large plastic button actuator easy to operate with hand. Extremely accurate repeatability and long mechanical life (5,000,000 operations) makes switch ideal for machine control. Diecast case protects switching mechanism, provides convenient mounting and connection for conduit. SPDT, 2 circuits, at 10 amps, 125/250v AC.

STANDARD OR "ONE-WAY IMPULSE" ACTION

Two models: ES4-J "makes" and "breaks" circuit as actuator is depressed, then released. ES4-JM sends electrical impulse as actuator is depressed. Overtravel opens circuit; no impulse on return.

see our catalog in Product Design File or write for copy

WRITE FOR DETAILS IN DATA SHEET ESF-9

ELECTRO-SNAP SWITCH AND MFG. CO.
4224 West Lake Street, Chicago 24, Illinois

HYDRAULIC STABILIZING SYSTEM

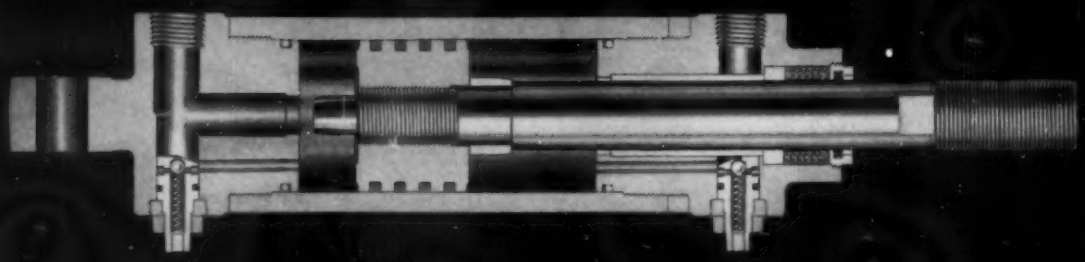
type, three-way valve, which varies pump stroke through two servo pistons. The electric servo drive, which positions the input shaft of the servo valve, is capable of stroking the pump from zero to hard-over in about 0.3 seconds. A mechanical limit stop arrangement, which can overpower the electric servo drive, through a clutch, is used to coerce the pump stroke to zero before the fin tilt cylinder hits hard stops. This limit stop device can reduce the pump stroke from 100% to zero in 0.2 seconds.

These rapid stroking rates are required for tracking false angles caused by wave action, and for positioning the fin rapidly in response to ordered lift requirements. Fin lift feedback, the primary controlling function of the stabilizer system, automatically compensates for false angles of attack, thus assuring the application of the correct stabilizing moment.

• **Two systems**—Two large solenoid-operated valves direct flow from the main pump to two separate systems. One system, consisting of two clevis-mounted cylinders connected together by a yoke, provides the power necessary to rig the fin in and out. Complete stowing of the fin would be a lengthy and tedious process were it not for the fact that water forces on the fin, due to the ship's motion, are in the right direction to perform most of the work. Two manually-operated, spring-offset valves are used to bypass the tilt cylinder and rig cylinder. Operation of one of these valves brings the fin to within a few degrees of center, due to the weathervane effect of the fin moving through the water.

The second system, consisting of a double-ended cylinder connected to the fin shaft by a crank and crosshead, provides the power required to tilt the fin through angles of plus or minus 25°. The two large solenoid-operated valves are connected in series on the pump side, so that either system may be conveniently operated by energizing the proper solenoid. The valves are large enough to take the full 110 gpm output of the pump with negligible pressure drop. Bypassing the flow from the pump allows the driver motor to be started under no load. Pilot pressure to position the main spool of the valve is taken off one of the auxiliary pumps through a check valve. This safeguard prevents accidental operation of the valve due to pressure fluctuations. Valve spools are spring-loaded to block the outlet lines when the solenoids are de-energized. This provides a fail-safe feature, as the fin is stopped immediately in the event of a solenoid or power failure. Possibility of power failure requires provision of manual means for securing the system. This is accomplished through a manual pump and two directional valves. These are standard manually-operated, four-way valves with a center-off position. Another brake or anti-runaway valve meters the return oil from the cylinders when the manual pump is operated. This valve blocks off return oil until a positive pressure is built up in the opposite side of the cylinders. ▼▼▼

Proved in performance



Pathon Hydraulic Cylinders

Performance Check List

1 Only Pathon offers a full line of Hydraulic Cylinders using a single screw thread to retain the cylinder head. You get extra compactness, low stress concentration, and greater resistance to shock loading.

2 Adequate space between the bearing points on all Pathon Hydraulic Cylinders result in:

(a) Increased bearing life. (b) Increased rod seal life. (c) Reduced power eating friction. (d) Provides a more rigid unit — eliminates rod cocking at the end of out stroke. (e) Eliminates need for internal spacers.

3 The single screw method of attaching the head to the cylinder results in extreme rigidity of the entire assembly. This combined with the absence of tie-rods makes cylinder with long strokes practical.

4 The head seal in all Pathon Cylinders is a true static seal and will give much longer life in operation.

103

Pathon MANUFACTURING COMPANY

3823 Pacific Avenue, Cincinnati 12, Ohio

HYDRAULIC CYLINDERS AIR CYLINDERS

HYDRAULIC DIRECTIONAL CONTROL VALVES

The *pump* in a hydraulic system will last *years longer* when you use *Lisle Magnetic Plugs.* The long-lasting powerful magnet in the Lisle plug pulls abrasive steel particles out of the fluid, thereby preventing their entrance into the pump and valves. Removal of these abrasive particles cuts down wear, assures longer, more efficient operation.

BEFORE AFTER

ENGINEERS . . . Write for free sample *Lisle Magnetic Plug* for testing. Please tell us the thread size you need. A complete catalog will be mailed to you without obligation.

LISLE Corporation

CLARINDA, IOWA

ROTARY AIR MOTORS

Concluded from page 87

air through the motor cools it. Expansion of the air within the motor also contributes to cooling.

Selection of the proper motor for a job, once the design analysis shows that an air motor should be used is simply a matter of matching requirements as closely as possible with available characteristics. Horsepower, speed, torque, mounting arrangement, size, weight, need for reversibility and cost must all be considered.

CONSTRUCTION DETAILS

To match speed and torque as well as horsepower to a job, gear reducers designed as an integral part of the motor are available. Available gear ratios range from approximately 2:1 to 75:1. Exhaust mufflers, throttle valves for unidirectional or reversible operation, filters and oilers are often standard equipment. Governors to prevent overspeeding of the motors are also often incorporated.

• ***Mountings***—Air motors of all types may be mounted either vertically or horizontally. Face, flange or foot-type mounts may be employed. In addition, special mounting arrangements for special applications, such as starting large diesel engines, are available.

• ***Shaft Types***—Straight shafts with flats, Woodruff keyways or square keyways are standard. Other types of shafts can be provided. One manufacturer will supply motors without shafts so the purchaser can use any desired types. ▼▼▼

APPLIED HYDRAULICS *acknowledges with appreciation the co-operation of the following companies in providing information used in the preparation of this article.*

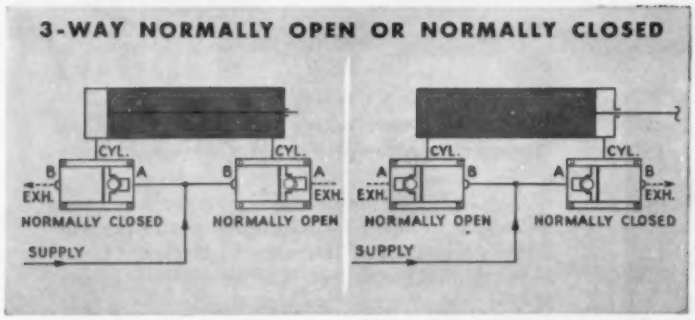
Aro Equipment Corp. .....Cleveland, O.
Chicago Pneumatic Tool Co. .....New York, N. Y.
Gardner-Denver Co. (Fig. 4) .....Quincy, Ill.
Gast Mfg. Corp. (Fig. 1) .....Benton Harbor, Mich.
Globe Pneumatic Engineering Co. Ltd. ..Romford, England
Keller Tool Div., Gardner-Denver Co. (Fig. 3) .....
.....Grand Haven, Mich.
Leiman Bros. Inc. .....Newark, N. J.
Onsrud Machine Works Inc. (Fig. 8) .....Chicago, Ill.
Oster Manufacturing Co. .....Cleveland, O.
Pesco Products Div., Borg-Warner Corp. (Fig. 2) .....
.....Bedford, O.
Rotor Tool Co. .....Cleveland, O.

Previous Article on Air Motor:

"Predicting Rotary Air Motor Performance," Kisselburg, E. T. and McCombs, W. F., Applied Hydraulics February, 1952. A discussion of the effects of air temperature, pressure and motor speed upon air motor hp, torque and efficiency. Methods for calculation are discussed and typical problems are solved for an existing air motor.

Simplified piping

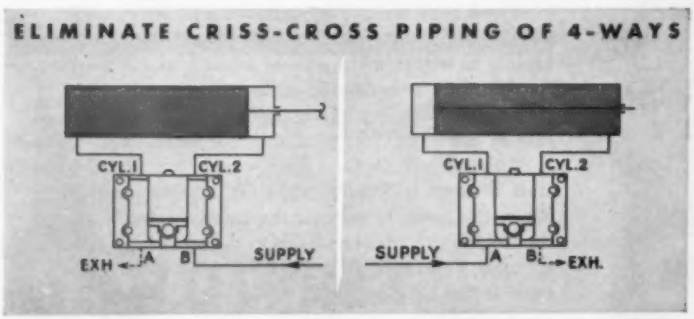
Another Plus Value in NOPAK-MATIC poppet-type air control valves



Simply pipe to proper port . . . no change in valve necessary

Piping supply to Port "A" provides Normally Closed operation — supply to Port "B" Normally Open operation. There are no changes to make in the valve . . . just pipe to the proper port. All 3-Way valves have two cylinder outlet ports for piping convenience.

The exclusive Nopak-matic "Flow-Director" pilot head automatically selects pilot pressure from whichever port is used as inlet. It eliminates purchasing special valves for each application or re-assembling of parts.



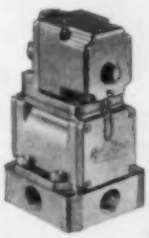
Simply pipe to proper port . . . no change in valve necessary

All Nopak-matic 4-Way valves can be piped with pressure to Port "A" or Port "B". Here again, the "Flow-Director" pilot head automatically selects pilot pressure from the inlet port. Flow through the valve is thus changed to meet the application requirements . . . eliminates criss-cross piping to the cylinder. There are no changes to make in the valve . . . just pipe to the proper port.

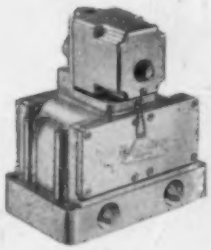
NOPAK-MATIC Plus Value Valves are available in ¼", ⅜", ½" and ¾" pipe sizes, for 2- or 3-Way Normally Open or Normally Closed operation with master (air), single or double solenoid pilot control heads.

300 SERIES
2,- 3-Way
Master Valves

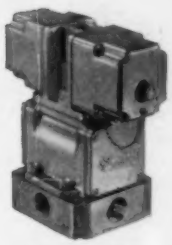
400 SERIES
4-Way
Master Valves



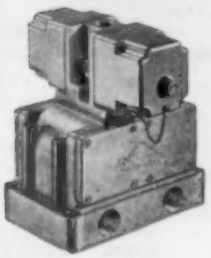
310 SERIES
2-, 3-Way
Single Solenoid
Pilot Operated



410 SERIES
4-Way
Single Solenoid
Pilot Operated



320 SERIES
2-, 3-Way
Double Solenoid
Pilot Operated



420 SERIES
4-Way
Double Solenoid
Pilot Operated

NOPAK-MATIC valves meet *all* J.I.C. Standards

NOPAK VALVES and CYLINDERS

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At the proper depth, a limit switch is actuated to start a timer holding the spindle at that position. When the timer times out, the spindle retracts and the locking cylinder retracts. On the up-stroke of the spindle, a limit switch is actuated to index the table to the next position.

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The rotary feed table is operated by a cylinder controlled by a 2-position, 4-way valve mounted on the end of the cylinder. This valve is operated by pilot air pressure and is controlled in one direction by an integral solenoid and in the other direction by a poppet valve mounted on the table. The poppet valve is opened by the rotary table cylinder at the end of its retract stroke. Solenoids for the rotary table valve, locking cylinder, and spindle feed are energized from a 110/8-volt transformer. This permits a very compact valve integral with the cylinder.

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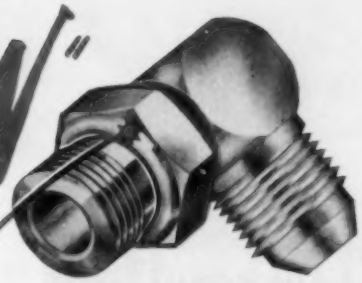

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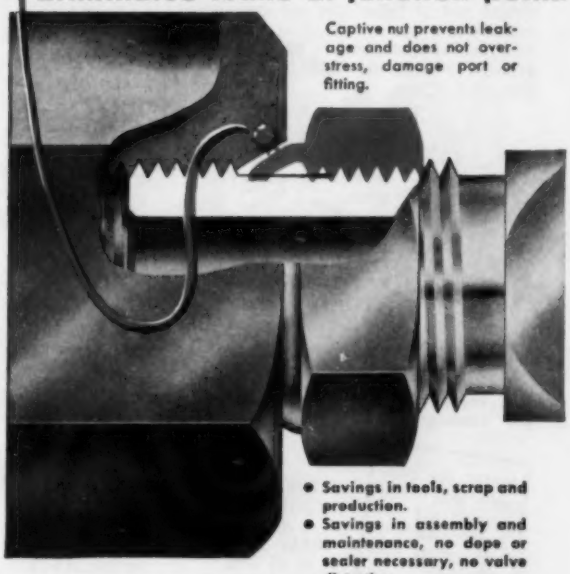

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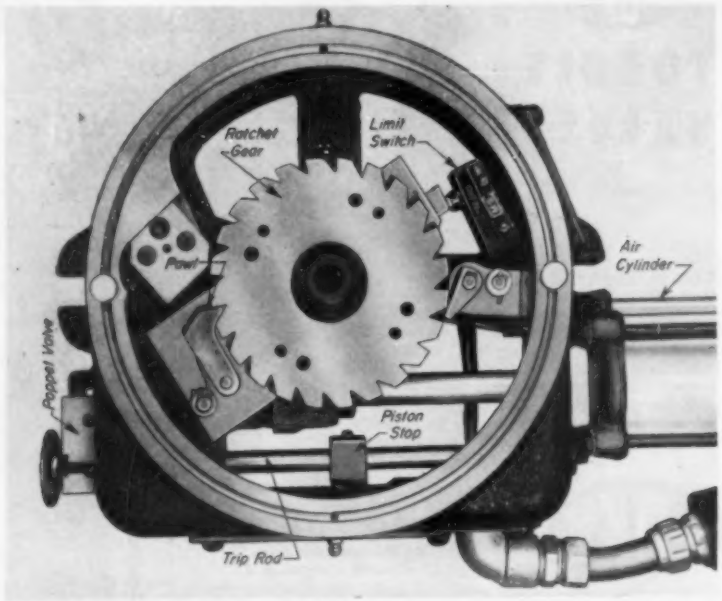
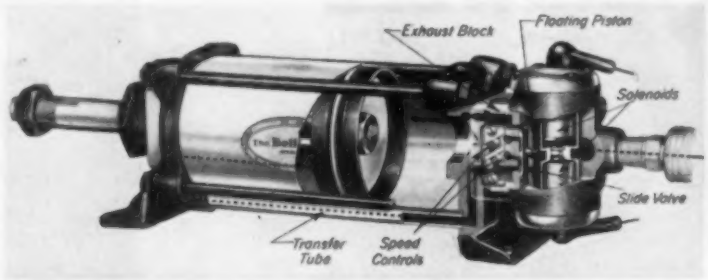


ROTARY FEED TABLE has a 10-inch table positioned by a 2½-inch air cylinder. Table top is doweled and screwed to ratchet gear, so that it can be rotated by the pawl. Electrically actuating the cylinder valve retracts the cylinder with the pawl overriding the ratchet until the position stop is reached. The setting of this stop determines the movement of the table, and standard units can be set for 90, 60, 45, 30, or 15 degrees. As the piston rod strikes the position stop it actuates the poppet valve through the trip rod. This exhausts air from the cylinder directional valve, so that the cylinder extends to rotate the table. Just before the completion of the index stroke, the limit switch is momentarily actuated to extend the locking cylinder and tool feed. The Bellows Co.



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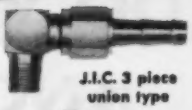

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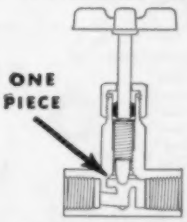

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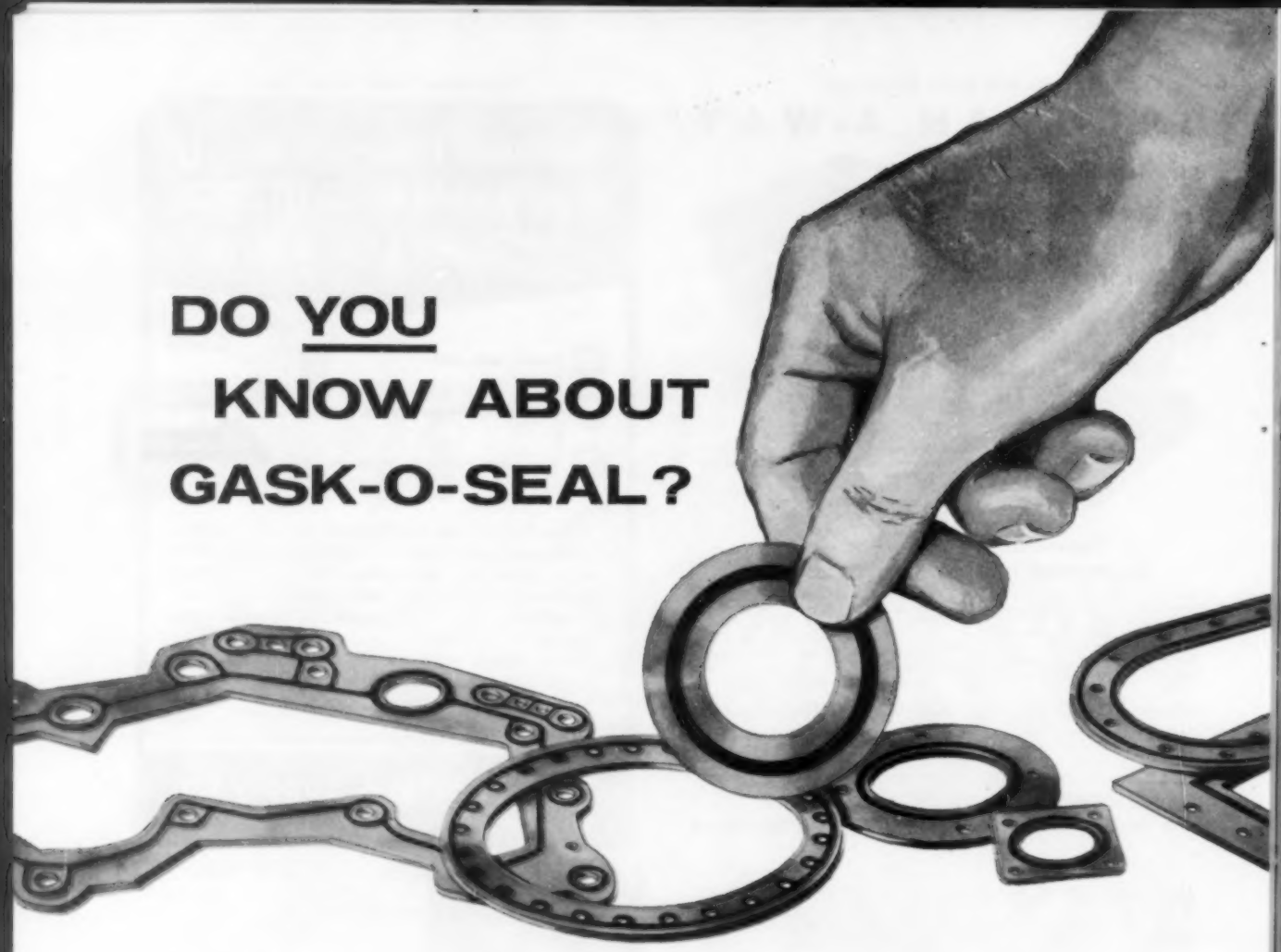

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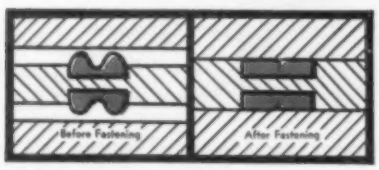

The above diagram is "typical" only. Gask-O-Seals are also made with one-side seals.

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AVIATION SECTION

Applied Hydraulics

SEPTEMBER 1957

HIGH-PRESSURE COMPRESSORS

. . . using bladder-type accumulators 143

By Larry Winston

Circuits and design equations for hydropneumatic accumulators used as high-pressure gas compressors with pulsating or constant output flow.

AIRCRAFT HOSE

. . . cure date and age control 150

Latest regulations established for hydraulic and pneumatic hose in ANA Bulletin 427 are summarized for quick reference.

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AVIATION COMPONENT DATA 156

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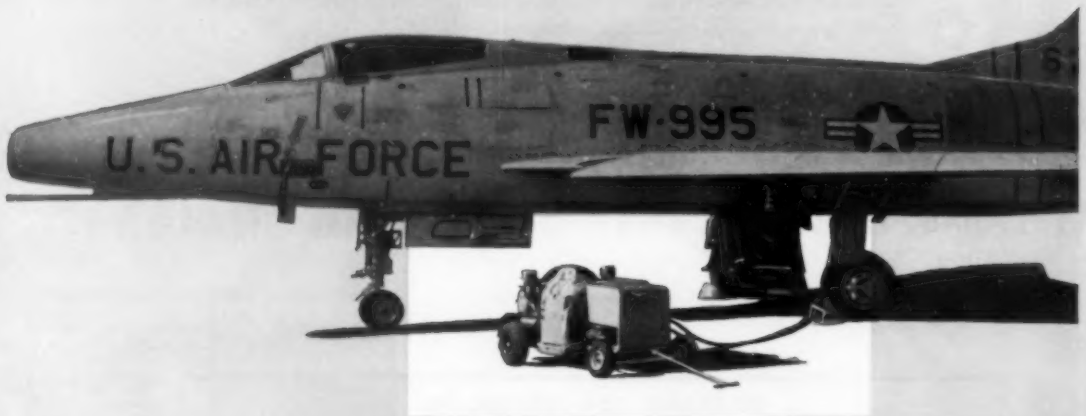

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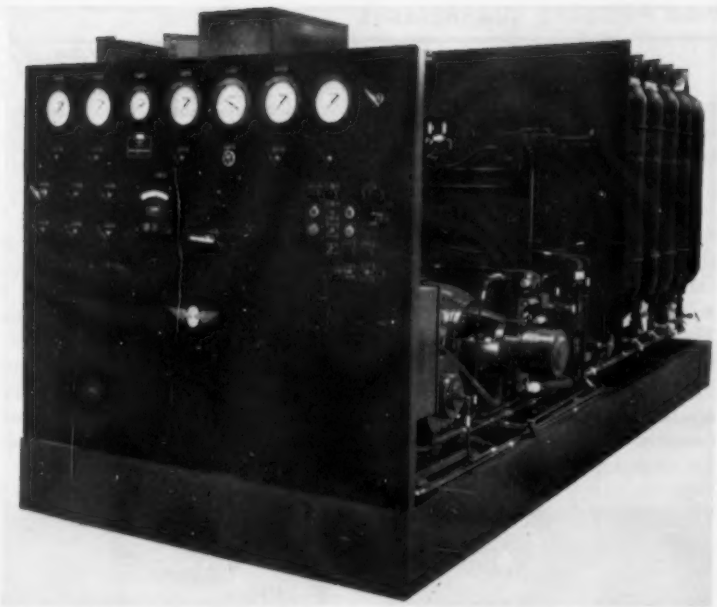
ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

Nitrogen, helium and oxygen at pressures up to 10,000 psi, are used for charging missile systems prior to flight, charging large, high-pressure gas receivers at rocket test facilities and in small airborne gas supplies. Pressure requirement can be met by standard compressors. However, the additional requirements of chemical purity and high flow rates have resulted in the development of . . .



GAS BOOSTER systems using accumulators or transfer barriers as the compression device, take low, medium or high-pressure gas, and compress it. Output may be used to charge a receiver or may be gas at a substantial flow rate. One of these units is capable of boosting pressure to 10,000 psi at flow rates of 10,000 scfh.

HIGH-PRESSURE COMPRESSORS

. . . *using bladder-type accumulators*

● By Larry Winston

Manager, Test Equipment Div., Sales Engineering, Greer Hydraulics Inc. New York, N.Y.

IN MOST ACCUMULATOR applications, gas contained in the accumulator functions as a spring to force oil out of the accumulator. However, it is also possible to force oil into the accumulator for the purpose of compressing the gas in the accumulator to a high pressure. An analogy can be drawn between an accumulator, Figure 1, and the conventional piston-type compressor. Oil is the connecting rod, the accumulator bladder is a perfectly sealed piston and the accumulator shell the cylinder.

However, one essential modification must be performed upon an accumulator before it may be used for gas compression. The air charging valve stem is removed and a perforated tube installed in its place, Figure 2. Purpose of the tube is to prevent extrusion of the bag through the port ordinarily used only for charging the accumulator. In this application, this port becomes a very important working port.

A bladder-type accumulator used as a compressor is called a transfer

barrier because the bladder prevents contamination of the gas being compressed. In operation, gas enters through the check valve, is compressed when oil enters through the oil port and then discharged through a second check valve.

• **Compression Systems**— There are two basic gas compressor systems. The first is a pulsating system with a discharge characteristic similar to a reciprocating compressor. Such a system is used for charging a receiver or other applications where this pulsating characteristic is acceptable. Second of the two basic systems is called a shuttle system and has a constant mass flow characteristic.

In the pulsating system, Figure 3, the K bottle manifold is connected to the system consisting of the transfer barrier, check valves, and receiver. Opening the shut-off valve at the K bottles then allows the gas in the bottles to expand into the transfer barrier and the receiver. System pressure, P_s, after this expansion is

$$P_s = P_K \left(\frac{V_K}{V_K + V_a + V_r} \right)^n \ldots (1)$$

where: P_k = initial pressure in the K bottles
V_k = volume of the K bottles
V_a = transfer barrier volume
V_r = receiver volume

Oil is then pumped into the transfer barrier for the compression stroke. Only the mass of gas in the transfer barrier and receiver is then compressed because of the check valve in the line from the K bottles. Pressure in the receiver, P_r is then

$$P_r = P_{ar} \left(\frac{V_{a1} + V_r}{V_r} \right)^n \ldots . (2)$$

where V_{a1} = volume to which the accumulator bag is compressed by the admitted oil.

The pump is then unloaded and additional gas flows from the K bottles into the volume of the transfer barrier and ahead of the receiver, since receiver pressure is now higher than pressure upstream of check valve 2.

Pressure in the transfer barrier to be boosted is now some new value P_{ka}, and is

$$P_{ka} = P_{k'a} \left(\frac{V_K}{V_K + V_a} \right)^n \ldots (3)$$

This pressure is now boosted to a volume V_{a2} such that pressure in the transfer barrier is equal to pressure in the receiver. At this point check valve 2 opens and further oil flow into the accumulator also results in compression of the gas in the receiver. Volume at this point is

$$V_{a2} = \left(\frac{P_{ka} (V_{a1})^n}{P_r} \right)^{1/n} \ldots . . (4)$$

where V_{a2} = volume available in the transfer barrier at pressure P_r to do further useful work in loading the receiver.

Total volume to be compressed from pressure P_r to a new pressure P_{r1} is $V_{a2} + V_r$, and

$$P_{r1} = P_r \left(\frac{V_{a2} + V_r}{V_r} \right)^n \ldots (5)$$

This process is repeated until the receiver pressure reaches the required value.

Operation of the shuttle system for mass flow of compressed gas will be illustrated by analyzing a sample system for compressing shop air at 75 psi to hold pressure

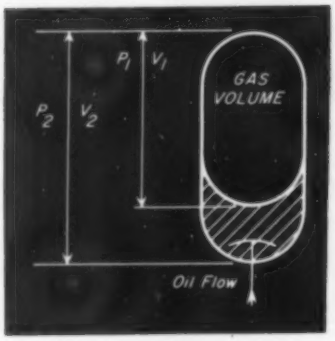


FIG. 1. A BLADDER-TYPE accumulator may be compared with a piston-type compressor. Oil in the accumulator corresponds to a connecting rod; bladder is the equivalent of a perfectly sealed piston, and the accumulator shell is the cylinder.

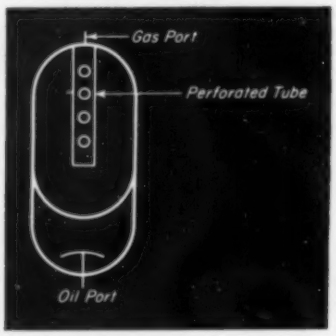


FIG. 2. AN ACCUMULATOR used for compressing gases is called a transfer barrier. There is one important difference between a transfer barrier and a hydraulic accumulator. A perforated tube is incorporated in the transfer barrier to prevent the bladder from being forced through the gas port.

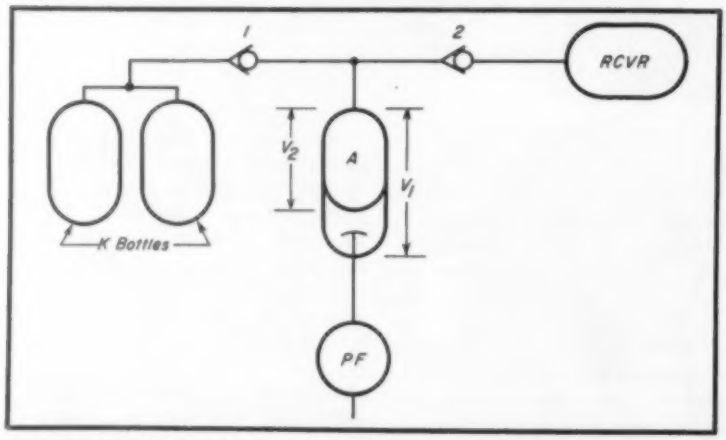
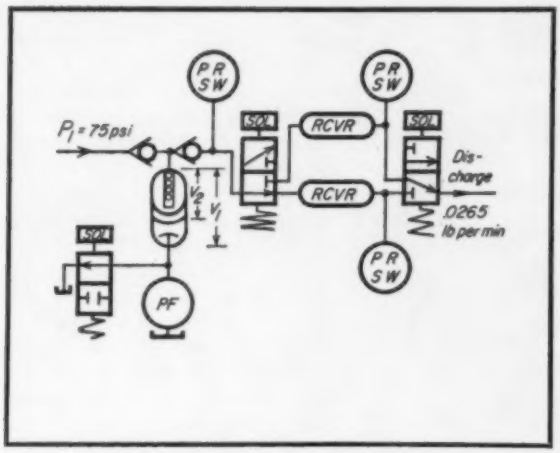


FIG. 3. OUTPUT of this type of gas booster system is intermittent. Such a system may be used for charging a receiver or other applications where this pulsating discharge characteristic is acceptable.



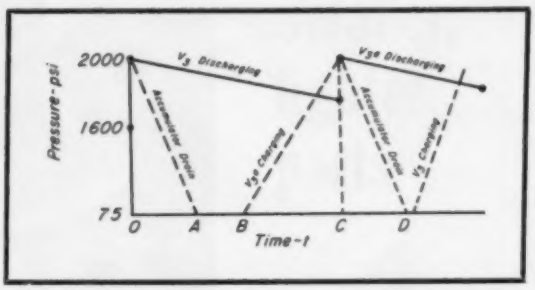


FIG. 4. A SHUTTLE system using two receivers in conjunction with a transfer barrier will produce a continuous flow of compressed gas. Pressure-time diagram shows how one receiver is charged while the other is being discharged. The diagram also shows that in design calculations, time must be allowed for draining the accumulator.

in a receiver between 1600 and 2000 psi while 0.0265 lb per min is being withdrawn from the receiver. In this system, Figure 4*a*, the accumulator operates between 75 and 2000 psi while receiver *a* is being charged from 1600 to 2000 psi and receiver *b* is discharging from 2000 to 1600 psi. This cycle is graphically represented by Figure 4*b*.

Since pressure in the accumulator at V_2 must be at least 1600 psi before the check valve to the air receivers will open, ratio of $V_1 : V_2$ must be the inverse of 1600/75, or V_2 equals 0.047 V_1. This assumes isothermal compression. Now, $(V_2 + V_3)\ P_2 = P_3 V_3$ where V_3 is total volume of the receiver and $P_3 = 2000$ psi, the final pressure desired. Then

$$V_2 + V_3 = \frac{P_3 V_3}{P_2} = \frac{2000}{1600} V_3 \quad \ldots . (6)$$

Therefore, $V_2 = V_3/4$. Value of $V_2 = 0.047\ V_1$ has already been established. Thus, $V_3/4 = 0.047\ V_1$ or $V_3 = 0.188\ V_1$.

Rule for selection of a transfer barrier for this application is: Use the smallest available size which provides the required degree of compression. At first it may seem that this is not very restrictive. However, an actual example will illustrate the point. So far in the illustrative problem, the matter of line volume and the fact that only 97% of the volume of the transfer barrier is usable have been ignored. To show how these affect the problem, a transfer barrier of

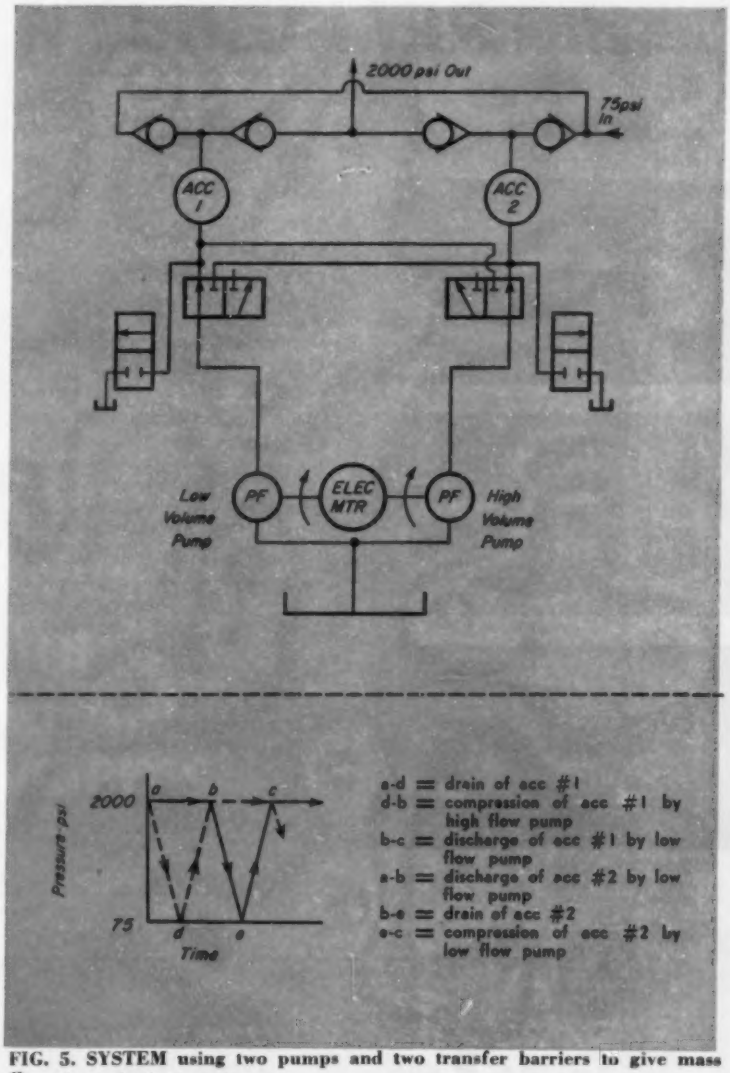


FIG. 5. SYSTEM using two pumps and two transfer barriers to give mass flow at constant pressure.

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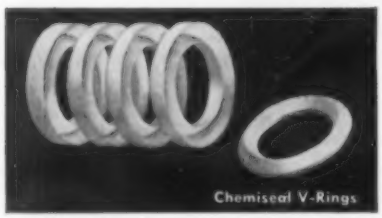

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COMPRESSORS

AVIATION

30 cu in. volume is first selected.

With $V_1 = 30$ cu in., $V_3 = 0.188 \times 30 = 5.64$ cu in. However V_3 must be modified by addition of the volume of the lines between the two check valves and the unusable portion of the accumulator volume. In this case volume of the lines is 0.2 cu in. and the unusable portion of the accumulator volume is 3% of the total volume or 0.9 cu in. Therefore, V_3 becomes 6.74 cu in. V_1 must be modified by the addition of the volume of the lines between the check valves. It is then 30.2 cu in.

Initial step in the process then becomes the compression of 30.2 cu in. of air at 75 psi until 1600 psi is reached, the point at which the check valve to the receiver opens. Mathematically

$$P_1V_1 = P_2V_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

or

$$V_2 = \frac{P_1V_1}{P_2} = \frac{75 \times 30.2}{1600} = 1.415 \text{ cu in.}$$

At this point, the check valve opens and the volume of gas at 1600 psi to be compressed to the final pressure becomes V_2 plus the receiver volume or $V_2' = 1.415 + 5.64 = 7.055$ cu in. Then for the final step

$$P_2 = \frac{P_2V_2'}{V_2} = \frac{1600 \times 7.055}{6.74} = 1680 \text{ psi}$$

Obviously, the required 2000 psi cannot be attained with this accumulator and receiver combination, since the overall compression ratio is not high enough.

There are two obvious ways to increase the compression ratio. One is to increase the size of the accumulator. The other is to decrease receiver size. Actual construction of the system revealed that the process already departed from isothermal by enough so that the actual compression exponent was 1.2. It was therefore decided to go to an accumulator of 60 cu in. (next largest size) rather than reduce receiver size since the reduced receiver volume would also require higher flow rates in and out of the accumulator which in turn would produce more heat and cause further departure from iso-

Continued on page 148

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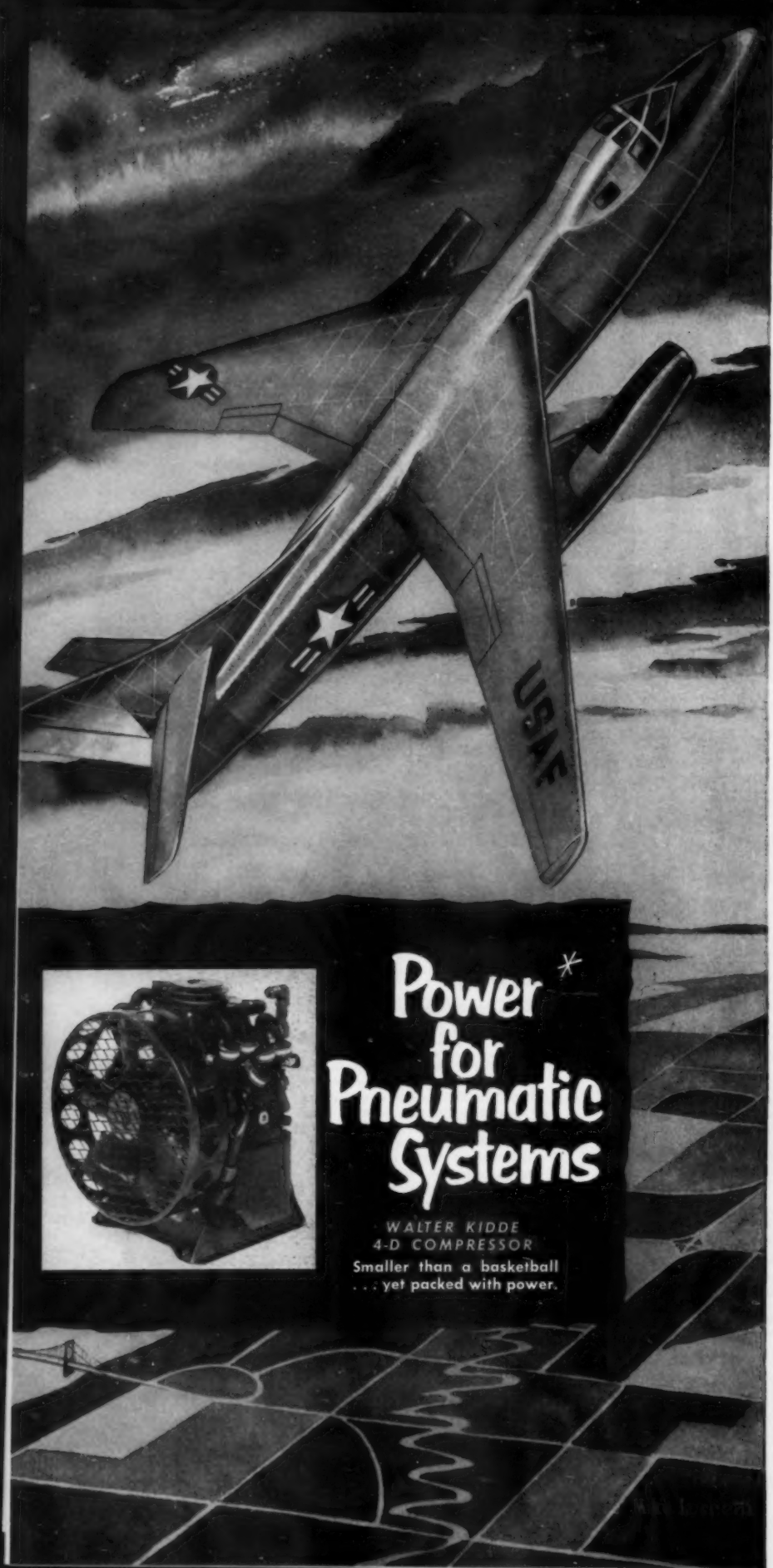

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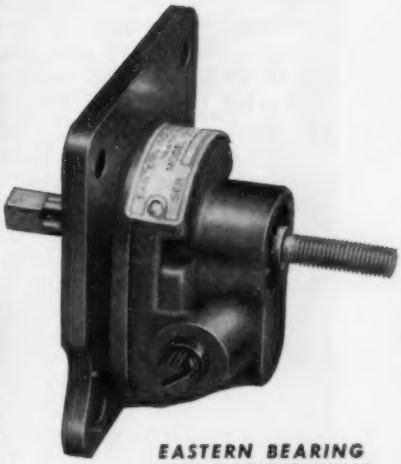

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thermal. At this point it should be obvious that selection of an accumulator for gas compression is not defined by formula. However, experience does make it possible to come close with the first approximation. A closer approximation to actual compression is also obtained by considering the compression process to take place adiabatically with the exponent being 1.2. That is

$$PV^{1.2} = K \quad \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Time available for charging and discharging the accumulator is found by first determining discharge times of the receivers. Assuming zero line volume and temperature of 540 R, mass of air in the receiver at 2000 psi, M_1, is

$$M_1 = \frac{P_1 V}{R_t} 1 = \frac{2000 \times 144 \times 5.64}{1728 \times 53.4 \times 540} = 0.0326 \text{ lb}$$

and the mass at 1600 psi is 1600/2000 (0.0326) = 0.0261 lb. The difference or usable volume which may be withdrawn from the receiver is, therefore, 0.0065 lb. This volume divided by the specified rate, 0.0265 lb/min, gives a useful discharge time of 14.7 sec.

To determine pump size, it is necessary to compute the amount of oil which must be pumped into the accumulator to achieve the required compression during this time. In this case, this is 56 cu in. Therefore, the pump must have capacity greater than 56 cu in. in 14.7 sec. One additional factor must be taken into account. Time for accumulator draining is included in the 14.7 sec receiver discharge time. Therefore pump capacity should be increased by 25% to allow adequate time for that essential portion of the cycle. Then

$$Q = \frac{56}{14.7} (1.25) = 4.75 \text{ cu in. per sec}$$

With this pump capacity, accumulator charging time is 11.8 sec. This interval corresponds to time *B* to *C*, Figure 4*b*. Of the total 14.7 sec interval, 2.9 sec then remains for discharging the accumulator.

• **Control System**—Correct sequence of events in this system is controlled by pressure switches, a stepping switch and solenoid valves. The valve in the pump drain line is controlled by a pressure switch on the discharge side of the accumulator. When pressure reaches 2000 psi, the valve is opened to drain the accumulator. Pressure switches sense oil pressures for points A, B, C, D of Figure 4b and operate a rotary solenoid-driven stepping switch to appropriately connect the two receivers.

• **Modified System**—An alternate system for obtaining the same result is shown in Figure 5. This system uses two pumps and two accumulators to give a constant discharge flow without receivers. A high volume pump is used to compress the gas in the accumulators. The low volume pump maintains pressure in the accumulator which is discharging. ▼▼▼

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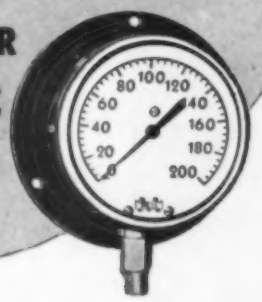

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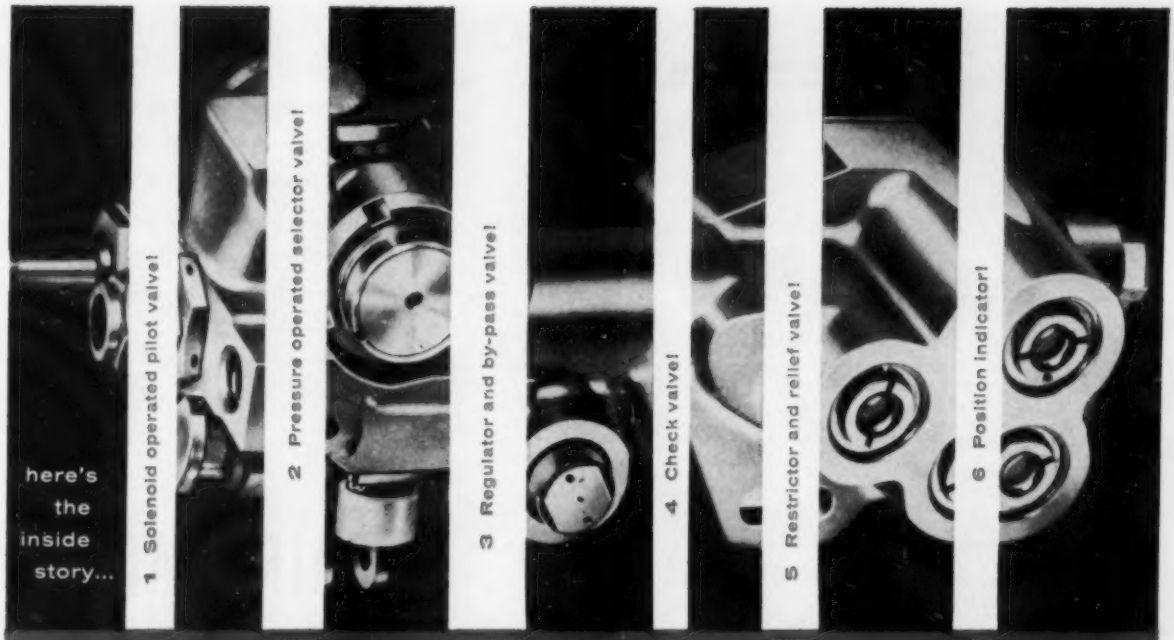
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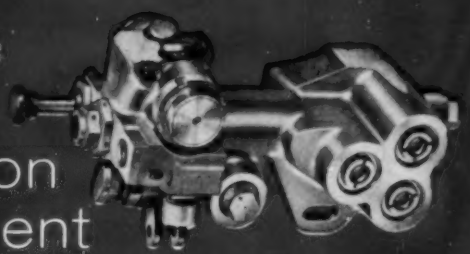

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Table 1—Hose Classifications

BULK HOSE (Aircraft-Rubber)

Press. Class	Mil-Spec	Service	Age Control
Low Press.	Mil-H-5593A	Gen'l. L. P. and instrument	Mil-H-5593A
Med. Press.	Mil-H-8794	Fuel, Oil, Alcohol, Hydraulic, etc.	Mil-H-8794 ANA Bulletin 427
High Press.	Mil-H-8788	Hydraulic	ANA Bulletin 427

HOSE ASSEMBLIES

Press. Class	Mil. or other Spec. Ass'y.	Hose	Service	Age Control
1) L. P.	AN6270	Mil-H-5593	Gen'l. L. P. and Instrument	AN6270 Mil-H-5593A
2) M. P.	Mil-H-8795	Mil-H-8794	Fuel, Oil, Alcohol, Hydraulic, etc.	Mil-H-8795 ANA Bulletin 427
3) H. P.	Mil-H-8790 MS28759 MS28762 Mil-H-5512B AN6292 MS28751	Mil-H-8788 Mil-H-5512B	Hydraulic	ANA Bulletin 427 Mil-H-8790 Mil-H-5512B

Table 2—Special Purpose Hose Assemblies

Press. Class	Spec.	Special or Distinguishing Features	Service	Age Control or Limitations Expected
4) M. P.	Proposed Mil-H-25579	Polytetrafluorethylene (Teflon) Tube	Jet fuel syn. oils, acids, hydraulics, etc. to +450° F.	Practically unlimited
5) H. P.	Proposed	Polytetrafluorethylene (Teflon) Tube	Hydraulic & other H. P. fluid systems to +400° F.	Practically unlimited
6) M. P.	None Ref. Mil-H-8794 Ref. Mil-H-8795	Special tube for synthetic hydraulic fluids (Skydrol)	Hydraulics	Same as Mil-H-8795 Assemblies
7) H. P.	None Ref. Mil-H-8788 Ref. Mil-H-8790	Special tube for synthetic hydraulic fluids (Skydrol)	Hydraulics	Same as Mil-H-8790 Assemblies

Table 3—Hose Life in Quarters

A) Receipt of Bulk Hose by equipment or aircraft, contractors, subcontractors, or the gov't. from hose couplers or hose mfgrs.	4	4	4	Unl.	Unl.	4	4
B) Receipt of uninstalled hose ass'ys by equipment or aircraft contractors, subcontractors, or the gov't.	4	4	4	Unl.	Unl.	4	4
C) Receipt of uninstalled hose ass'ys by the gov't. from other than hose couplers, such as in kits or spares from contractors or subcontractors.	6	6	6	Unl.	Unl.	6	6
D) Receipt of hose assemblies installed in in aircraft by the gov't.	16	16	16	Unl.	Unl.	16	16

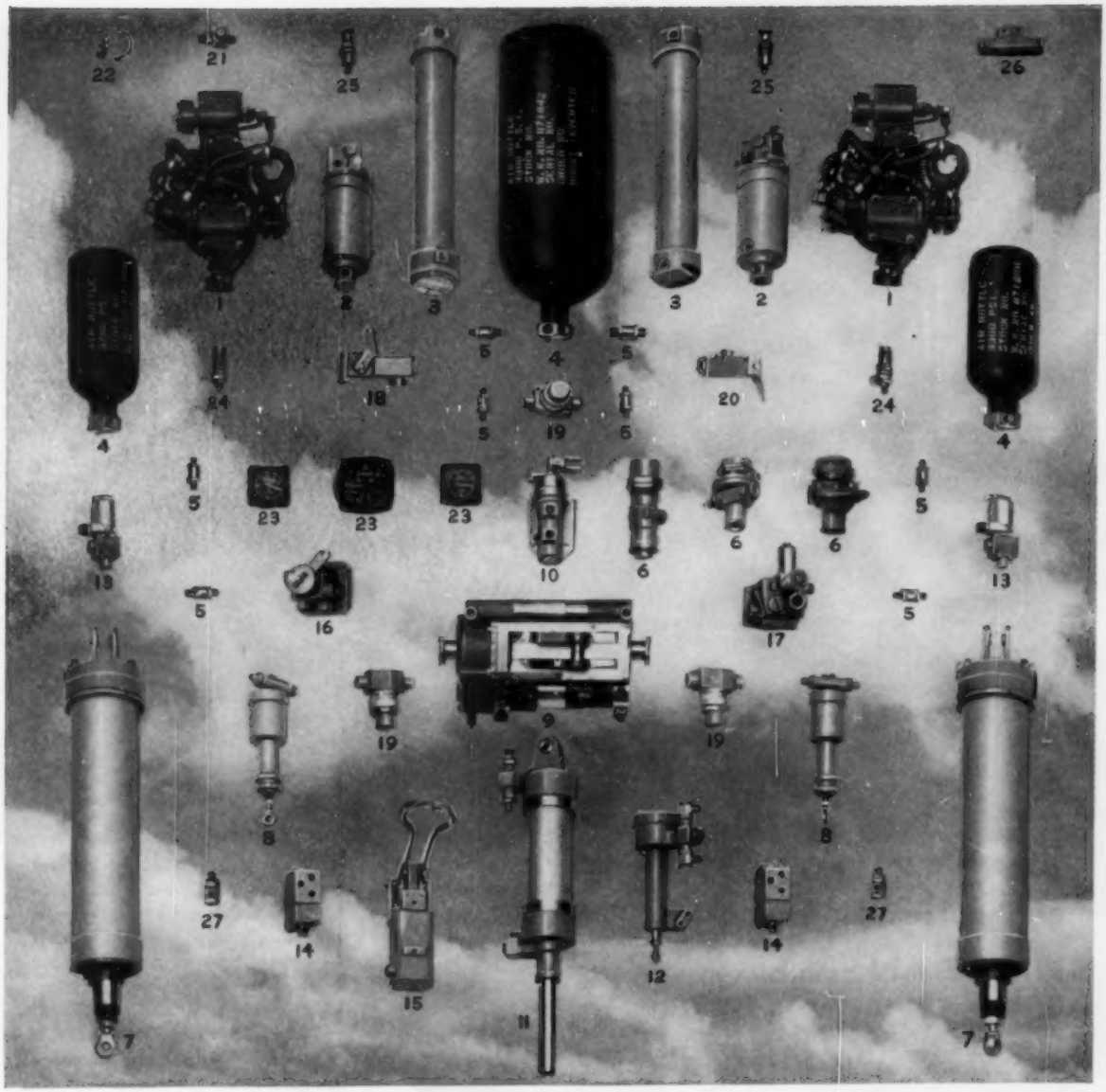
Keeping track of the age of hose assemblies between the time of manufacture and the time they are placed in service is a small but important problem for aircraft hydraulics and pneumatics people. Here's the latest information on the subject

AIRCRAFT HOSE

. . . cure date and age control

THERE are literally miles of hydraulic and pneumatic hose in today's aircraft. Proper age control can be a troublesome task. Storage time limitations for the majority of aircraft hydraulic and pneumatic hose are established by ANA Bulletin 427 and are based upon quarterly cure dates which are incorporated in the manufacturer's markings. Provisions of this bulletin for the various types of hose and hose assemblies are summarized in this article.

• **Pressure Classes**—Aircraft hoses are manufactured in three basic pressure classes—low, medium and high. Low pressure hose, used chiefly for air and vacuum systems as well as gage lines, is constructed with single cotton braid reinforcement and an inner tube and outer cover of synthetic rubber.



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*8. Actuator, up lock main gear
9. Actuator, nose wheel steering
10. Valve, servo, nose steering
11. Actuator, nose gear
12. Actuator, up lock nose gear
13. Valve, propeller brake
14. Valve, wheel brake
15. Valve, emergency brake
16. Valve, emergency landing gear
17. Valve, solenoid, landing gear
18. Valve, manual, isolation
19. Filter
20. Valve isolation
21. Pressure relief
22. Valve, ground charging
23. Pressure gauges
24. Valve, relief
25. Valve, back pressure
26. Shuttle valve
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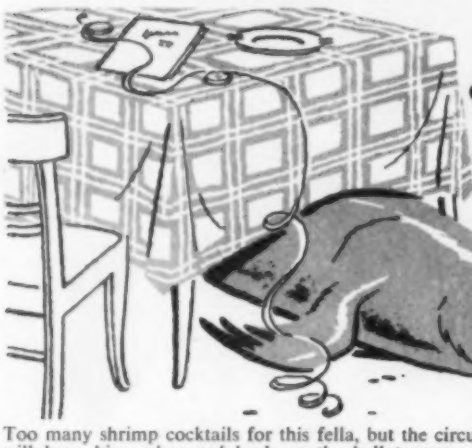

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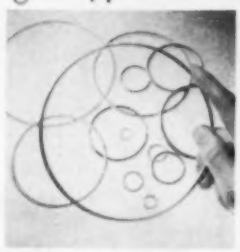

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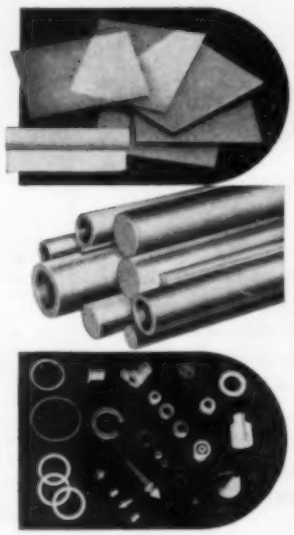

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AIRCRAFT HOSE

AVIATION

Medium pressure hoses are used for carrying fuel, lube oil and alcohol as well as hydraulic fluid. They are constructed with a single wire-braid reinforcement. High pressure hose has multiple wire-braid reinforcement and is used entirely for hydraulic service.

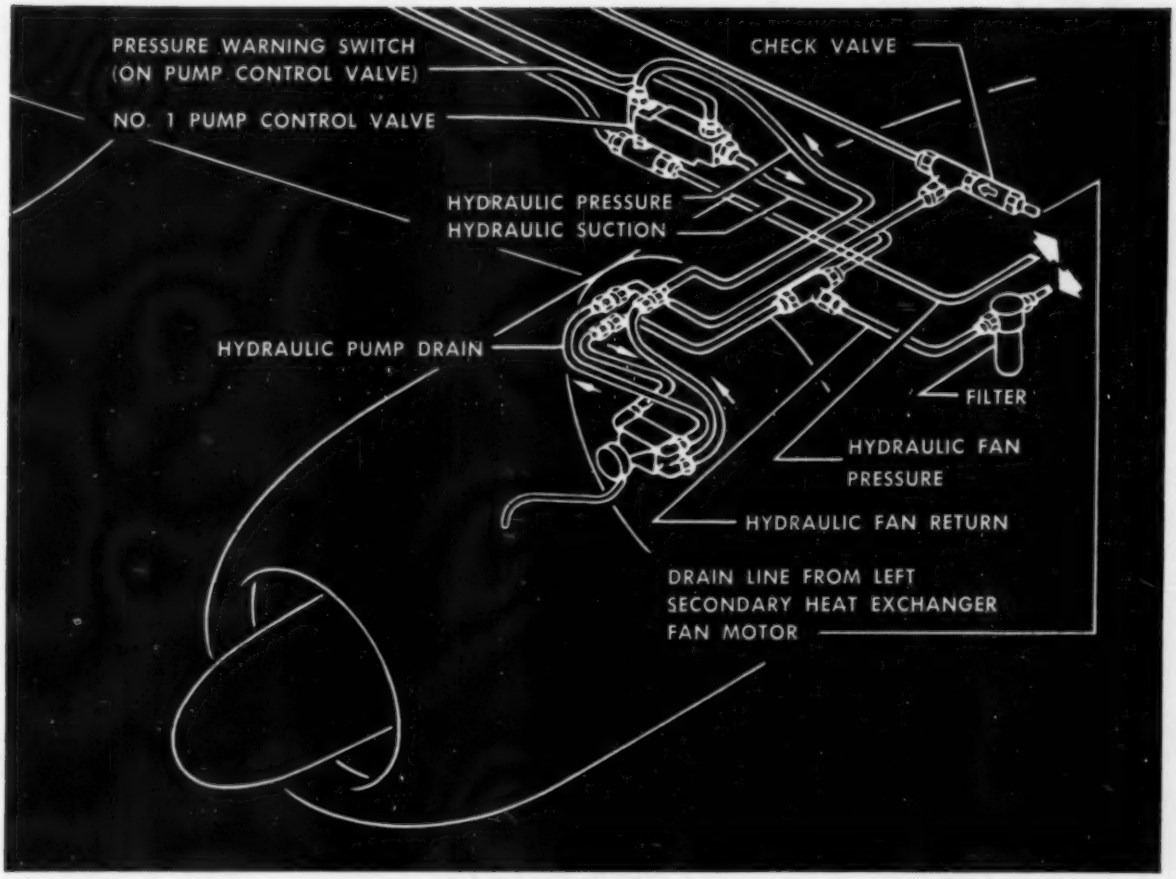
Pressure classification, general field of application, applicable specification and age control authority for bulk hose and hose assemblies are summarized in Table 1.

• **Special-Purpose Hose**—Although labelled special-purpose, these hoses fall within low, medium and high pressure groups. Table 2 identifies the hoses which fall into this category and lists their distinguishing characteristics. This group includes the so-called Teflon hose, hose having an inner tube of Teflon. This type of hose is not presently subject to age controls. However, age controls may be imposed upon Teflon hose at some future date.

• **Age Controls**—In general bulk hose or hose assemblies have a life of four quarters. This means that hose or hose assemblies must be received by users within four quarters of the time of manufacture or must be discarded as being too old. An exception to this is made for uninstalled assemblies supplied to the government for use as spare parts by other than hose assemblers.

Age accumulation starts in the quarter following manufacture. Hose manufactured in the first quarter of 1957, for example, has an elapsed life of one quarter until June 30, 1957. As of July 1, 1957 it is considered to be in the two quarter age group. The four quarters specified for receipt of this hose by aircraft contractors, etc. end as of March 31, 1958.

Elapsed time in quarters for receipt of all types of hose installed in aircraft is 16 quarters. Of course, this does not apply to the special-purpose types which are not covered by ANA 427. Table 3 summarizes this life data. ▼▼▼



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AVIATION NEWS

from the fluid power field

Sidney C. Howell was appointed assistant sales manager of **The Weatherhead Co., Aviation Div.**, Cleveland, O.

Stratopower Div., New York Air Brake Co., Watertown, N. Y. has set up three distributors to offer sales, service and overhaul facilities to civil aircraft operators from coast to coast: **Airwork Corp.,** Millville, N. J., **Southwest Airmotive Co.,** Dallas, and **Pacific Airmotive Corp.,** Burbank, Calif.

Bennett D. Jones, formerly manager of product development, **Standard Pressed Steel Co.,** Jenkintown, Pa., has been named to the new post of technical director in the company's Aircraft Div. Jones, at one time chief metallurgist for Standard Pressed Steel, will co-ordinate company research and product development activities with the needs of the aircraft and missile industries.

Bennett D. Jones
Aircraft Div.,
Standard Pressed Steel Co.

The Waldorf Instrument Co., Div. of F. C. Huyck & Sons, Huntington Station, N. Y. announces the appointment of **Fred A. Winzer, Jr.** to the position of vice president-sales. He will head Waldorf's new program to expand sales of precision aircraft hydraulic and mechanical products. For over 20 years, Waldorf has manufactured such equipment for eastern aircraft engine and airframe manufacturers.

LOS ANGELES—Plans for a multimillion dollar expansion of manufacturing and engineering facilities of **Weston Hydraulics, Ltd.** were recently announced. This subsidiary of **Borg-Warner Corp.** has purchased approximately 32 acres of land in Van Nuys, Calif, Construction of a 75,000 sq ft building for development and production of hydraulic and pneumatic equipment for aircraft, missiles and rockets will be first step in the program.

Main landing gear for the Fokker-Fairchild F-27 Friendship to be produced in this country by **Fairchild Engine and Airplane Corp.** will be purchased from the **Dowty Group Ltd.,** Cheltenham, England.

Volney F. Morin has been elected executive vice president of **Meletron Corp.,** and **William A. Clegern,** vice president in charge of product development.

Mr. Morin was resident cousel, Technicolor Corp. in Hollywood Calif. Mr. Clegern comes from Jet Engine Div., General Electric Corp., Cincinnati, O. where he was manager-marketing with responsibility for market research, product planning, government contracts and new product sales.

Appointment of two separate distributor organizations on the east and west coasts to handle the **Weatherhead** line of aviation products has been announced. **Pacific Airmotive Corp.,** Burbank, has been appointed distributor of Weatherhead products to airlines, private and business pilots as well as aircraft overhaul shops through its branches in Burbank, Oakland, Seattle, Kansas City and Denver.

Airwork Corp., Millville, N. J., will handle distribution and sales of Weatherhead aviation products through its branches at Miami, Fla., Alexandria, Va. and Newark, N. J. Each office is connected with the others by TWX to provide fast, efficient service.

SEATTLE—**Boeing Airplane Co.** has placed a contract with **Vickers Inc.,** Detroit, Mich., for hydraulic pumps to operate the flight control and the utility hydraulic systems of the B-52 bomber. Each plane will have six engine-driven, variable-displacement piston pumps and four variable-delivery motorpumps. Motorpumps furnish hydraulic power for the emergency spoiler system and augment the utility system.

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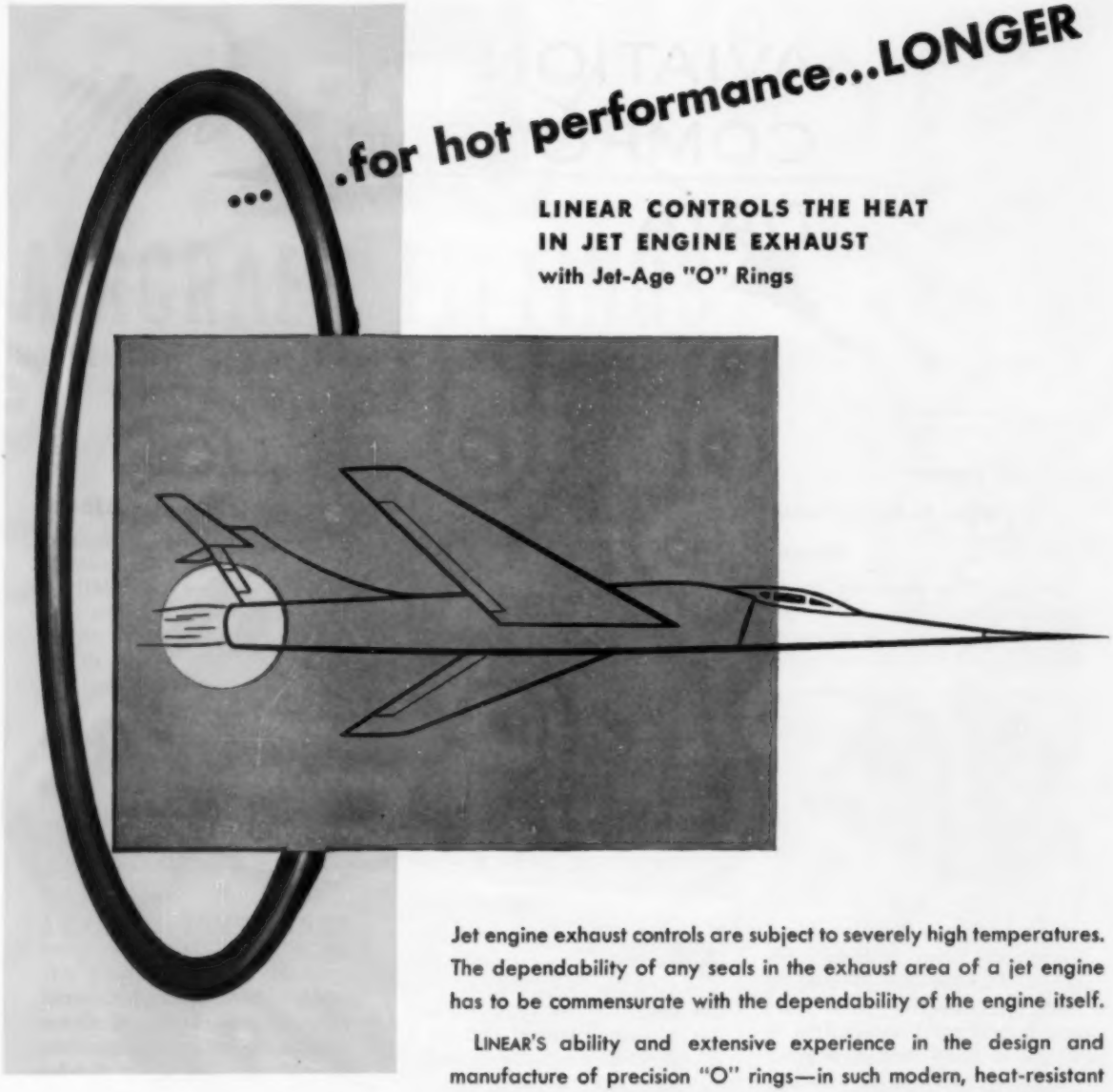
with Jet-Age "O" Rings



Jet engine exhaust controls are subject to severely high temperatures. The dependability of any seals in the exhaust area of a jet engine has to be commensurate with the dependability of the engine itself.

LINEAR'S ability and extensive experience in the design and manufacture of precision "O" rings—in such modern, heat-resistant elastomers as the silicone family—makes this kind of dependability a reality. LINEAR "O" rings, capable of withstanding intermittent ambient temperatures as high as 1000° F—and the destructive actions of gases and fluids, help control the jet engine exhaust—for hot performance—longer.

For a sealing problem of any kind—call on LINEAR or one of its agents for engineering assistance...

and be sure to Specify LINEAR "O" Rings for every application.

"PERFECTION IN RUBBER"
LINEAR
LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA. 35, PA.

AVIATION COMPONENT DATA

Shuttle Valve ... for wide temperature range

Designed for mounting on a double-acting cylinder, the MC 1733 shuttle valve is for alternate connection to normal system or

emergency system lines. Ambient temperature range is from —65 to 160 F. Operating pressure is 3000 psi; minimum burst pressure is 8750 psi. Pressure drop is 40 psi at rated flow of 6 gpm. Ports are for ⅜-in. tubing. Weight of the unit is 4.29 lb.—*MC Mfg. Co., Lake Orion, Mich.*

Circle 300 on Reader Service Card

Pressure Reducing Regulator ... for low pressures

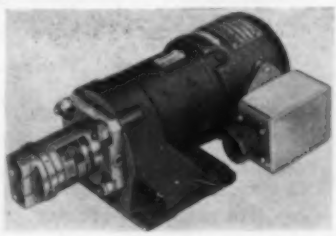
Developed especially for applications in aircraft and missiles, this pneumatic pressure reducing regulator is adjustable from 20 to 40 psig with accuracy better than 5 psi. Flow rates vary from slight bleed to 7 scfm. One application is supercharging hydraulic reservoirs. Unit has a large capacity integral relief valve which requires no separate adjustment. There is no external leakage.

Unit may be used with air, nitrogen or helium and is not affected by extreme altitudes. Ambient temperature range is from —65 to 250 F. Vibration resistance is 25 g from 25 to 2000 cps. Weight is 9 oz. Dimensions are: 2 1/16 x 3⅜ x 2 9/16 in.—*Val-Aero Div., Darco Industries Inc., Los Angeles, Calif.*

Circle 301 on Reader Service Card

Miniaturized Motorpump ... for missile applications

Model AA-19054 motorpump delivers 0.84 gpm at 7400 rpm and 1000 psi. Weight is 1.0 lb for the pump and 7.0 lb for the motor. Overall length of both is 9-15/16 in. Although life character-



istics are in keeping with missile requirements, overall efficiency is high. Starting troque is less than 110% of running torque. Electric motor is 28 v dc rated at 0.84 hp. Motor is equipped with a radio noise filter and is explosion proof.—*Vickers Inc., Detroit, Mich.*

Circle 302 on Reader Service Card

O-Ring Compound ... for Type II systems

This new compound, designated 737-70, is for service in aircraft hydraulic systems with MIL-O-5606 hydraulic oil over the temperature range of —65 to 275 F. Compound 737-70 meets all requirements of proposed specification MIL-P-25732 (ASG). All sizes on companion drawing MS28775 (Proposed) can be furnished from standard tooling.—*Precision Rubber Products Corp., Dayton, Ohio*

Circle 303 on Reader Service Card

PLANE-TYPE SWIVEL JOINTS ... offer weight and space-saving, and increased reliability of performance for aircraft piping systems. Design eliminates tube fatigue failure at connections. Many application layout sketches show use of these fittings. Bulletin AM-11, 22 pages, *Weatherhead Co., Cleveland.*

Circle 304 on Reader Service Card

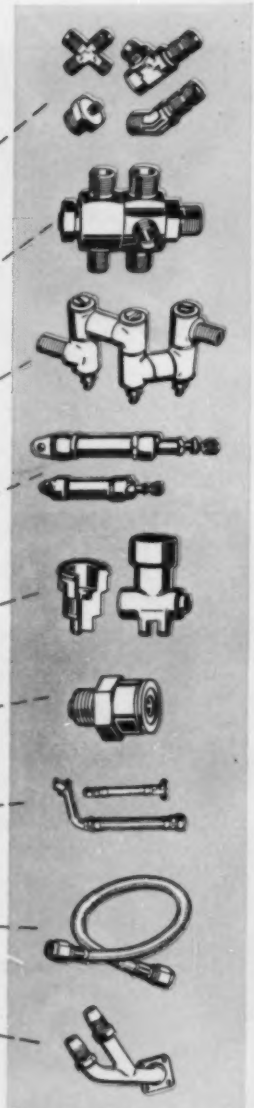
Portable Hydraulic Supply ... for missile checkout

Designed for use with OS-45 high-temperature fluid, this unit serves as a source of high-pressure fluid for precise circuit checkout prior to missile launching. Two independent circuits have capacities of 20 gpm at pressures to 5000 psi. For personnel

Continued on page 158

Your NUMBER 1 ONE SOURCE for AIRCRAFT FITTINGS

HOSE ENDS • HOSE ASSEMBLIES • SPECIAL PRODUCTS



For light weight, simplified configuration, and compactness in the fluid system you design . . . depend on Weatherhead fittings and components every time.

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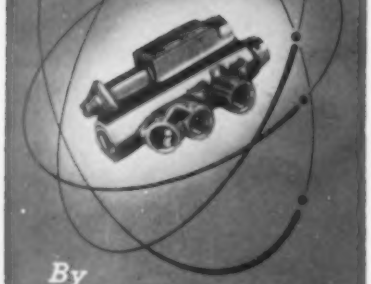
TRANSFER VALVES



By
M.C. MFG. CO.
The one shown is:
MC 1750 VALVE – TRANSFER SOLENOID OPERATED
fulfilling the following aircraft specifications:
FLUID: MIL-0-5606 Hydraulic Oil
OPERATING PRESSURE: 1500 psi
TEMPERATURE RANGE: –65°F to +165°F
PORT CONNECTIONS: Per AND 10050-8
INTERNAL LEAKAGE: 5 cc/min. max.
PRESSURE DROP: 25 psi at 6 GPM
SOLENOID: Applicable paragraphs of specification MIL-S-4040 Continuous duty .75 amps max. at 24 volt DC
OPENING OR CLOSING TIME: .10 seconds max. at rated pressure and flow
WEIGHT: 2.65 lbs.
MILITARY SPECIFICATION: Applicable paragraphs of MIL-V-5529 Non-interflow type

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VALVES OF ALL TYPES: Relief • Solenoid • Manual Control • Transfer • Shuttle • Brake • Control • Fluid • Pressure Reducing • Restrictor and Special

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AVIATION COMPONENT DATA

safety, the unit is designed for remote control.

Both overheat and backpressure control are incorporated in the circuits to shut off pressure and return, and dump pump output to tank in case of excessive heat or back pressure. Controls will not permit re-energization of either circuit until the trouble is fixed. Indicator lights are provided to pinpoint the trouble.

System features include automatic prefill and bleed of the circuits. A nitrogen purge pressurization system precludes fluid contamination. Control of the air-type

heat exchanger is automatic to maintain proper fluid temperature. Flow indication, system selection, on and off operation and emergency shutdown are all remotely operable. Unit is mounted on roadable running gear with lightweight Air Force arctic tires. Cooling system, electrical system and piping are reached for servicing through separate access doors.—*Haskel Engineering & Supply Co., Glendale, Calif.*

Circle 305 on Reader Service Card

Motorized Valves . . . provide smooth control

Designated #1701 Series, these valves provide smooth, positive directional and flow control. A 28 v dc motor drives a two-stage gear train to actuate the plunger. Basic valve provides two-way control with ½ in. plunger travel. Units for unidirectional control or with more plunger travel may also be supplied.

Qualification tested under MIL-V-5529 A and MIL-E-5272 A, the valve has a one-piece body and automatic current shutoff. Valve is 5.45 in. long and weighs 2 lb.

Ports are ½ in. per AND 10050-8. Pressure drop is 9 psi at rated flow of 6 gpm. Ambient temperature range is from —65 to 160 F.—*Lyndon Aircraft Inc., Newark, N. J.*

Circle 306 on Reader Service Card

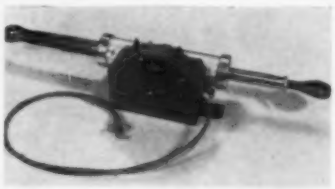
FLOW REGULATORS . . .

Their use in aircraft is graphically shown, and diagrams and charts explain principle of operation. Brochure, 8 pages, *Waterman Engineering Co., Evanston, Ill.*

Circle 307 on Reader Service Card

Servo Valve-Actuator . . . for accurate positioning

Low time constant and virtually infinite resolution are inherent in the mechanical feedback system



of this valve-actuator. Full actuator stroke requires error input of 0.06 w. Servo valve is dry coil torque motor type. Operating pressures are from 300 to 3000 psi. Jet fuel, MIL-O-5606 fluid or other similar liquid media may be used.—*Hydraulic Research & Mfg. Co., Burbank, Calif.*

Circle 308 on Reader Service Card

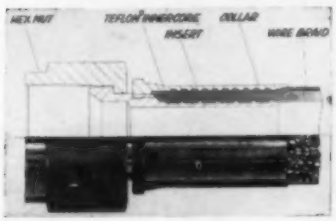
HIGH-TEMPERATURE HYDRAULIC FLUIDS . . .

Covers the role of these synthetic fluids in aircraft service, background information on what they are and how they are developed. Data is given on conformance of OS-45 with Air Force Spec. Mil-H-8446, giving complete data on physical properties, chemical and operational characteristics, and compatibility with other fluids. Pumpability and hydrolytic stability are discussed, and complete technical information is given in a section on general properties and miscellaneous information, including packings, seals, hose assemblies, backup rings, effect on fabrics, and toxicity data. Technical Bulletin ODB-57-30, 30 pages, *Monsanto Chemical Co., St. Louis, Mo.*

Circle 309 on Reader Service Card

Teflon Hose Fitting . . . for medium pressure

A new type of permanent fitting for Teflon hose consistently exceeds the requirements of MIL-H-25579 for medium pressure Teflon hose. A result of comprehensive



study and extensive testing, the new fittings retain the hose between an insert and a collar. Originally a loose fit over the wire braid, collar diameter is gradually reduced by radial pressure applied progressively along its length in a rotary hydroforming machine. This works plastic inner core and the braid toward the hex nut, resulting in a positive lock between braid and fitting, and between inner core, braid and insert. Amount and direction of flow of both plastic and wire braid are carefully controlled to obtain optimum force distribution.

Assemblies made with these fittings have passed military qualification tests for burst pressure,

Continued on next page

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GREER UNIVERSAL HYDRAULIC ACCESSORIES TEST MACHINES (HA SERIES)
Write for Greer Bulletin HA-100
For functional and operational testing of all types and sizes of aircraft and industrial hydraulic components such as valves, actuators, regulators, plumbing, tube and hose lines, manifolds, hand pumps; many others.
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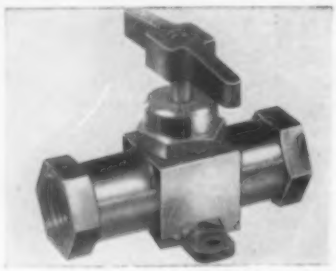
AVIATION COMPONENT DATA

proof pressure, temperature cycling and impulse. Specimens tested do not leak even after —70 to 450 F cycling. Various fitting configurations are available to meet customer needs, including straight fittings, 45 and 90 deg. elbows. Sizes range from 3/16 to 1¼-in. nominal diameter.—*Titeflex Inc., Springfield, Mass.*

Circle 310 on Reader Service Card

Ball Valve . . . has low operating torque

For use with air, fuel, hydraulic oil and most liquid or gaseous propellants, this straight-through



ball valve has zero leakage from 500 to 3000 psi. Operating torque is 20 in.-lb maximum. It is 3½ in. long and less than 1½ in. high. Unit has surpassed the most rigid MIL specs, shock and vibration tests.—*Eastern Aircraft Products Corp., Orange, N. J.*

Circle 311 on Reader Service Card

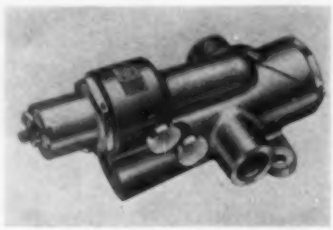
Lathe-Cut Rubber Rings . . . in large diameters

Lathe-cut rings in standard compounds or special elastomers to customer specifications are available in diameters of 5 in. and over. Rings are molded and lathe cut to meet all AMS and MIL specifications. Accuracy to ±0.008 in. can be maintained in large production runs. Rings may have a high mirror finish on ID and OD with sharp edges. If a slightly rounded edge is preferred, rings can be matte finished. Samples showing the two finishes are available.—*Acushnet Process Co., New Bedford, Mass.*

Circle 312 on Reader Service Card

Pressure Reducer . . . for 1000 scfm

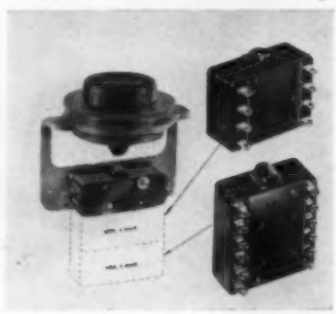
With inlet pressures up to 3000 psi, this reducer will maintain close control of outlet pressure and flow. Rated flows are up to



75 lb/min or 1000 scfm. Outlet pressure, as required, from 200 to 2800 psi. Relief pressure is 115% of outlet pressure. Maximum leakage rate is 5 cc/min of standard air. Ports are ½-in. tube size. Ambient temperature range from —65 to 180 F. Overall dimensions are 6.85 x 3.5 x 3.4 in. Weight is 1.87 lb. Integral bleed-down feature releases outlet pressure when inlet pressure is removed.—*Weston Hydraulics Ltd., North Hollywood, Calif.*

Circle 313 on Reader Service Card

Push-Button Actuator . . . for circuit flexibility

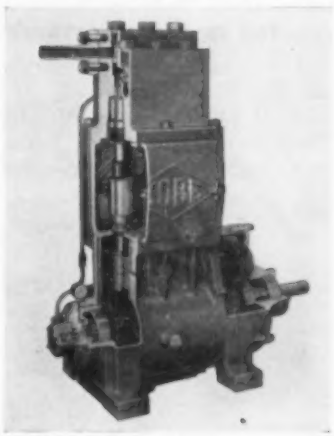


Manually-operated A4-67 actuator is designed to accept any of three standard basic switches without alteration of the bracket. This permits a wide range of switching arrangements from SPST to TPDT-6 circuit. Button is housed in an independent threaded bushing which screws into the bracket to act as an adjustment for panel thickness and also as a locknut. Panel thickness can vary from 1/16 to ⅛ in. A knurled ring nut permits fast, manual installation. All metal parts are corrosion resistant treated. Standard button colors are black, red and green. Special colors are also available. Basic switch units are both Underwriters and Military approved.—*Electro Snap Switch & Mfg. Co., Chicago, Ill.*

Circle 314 on Reader Service Card

High-Temperature Pump . . . for aircraft component tests

Rigid requirements of high-temperature, high-pressure component testing are met by the



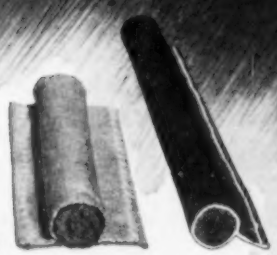
Kobe Triplex Pump. It may be used at temperatures in excess of 500 F at pressures to 5000 psi. An exceptionally heavy-duty pump, designed for round-the-clock service, it has closely fitted, metal-to-metal plungers and liners which eliminate the need for seals. Plungers and liners in a variety of sizes provide varying pressures and volumes and are easily interchanged.

A forged steel fluid head is separated from the crankcase by a one-piece steel spacer block which insulates heat from the crankcase. This keeps temperature of oil in the crankcase down even during

Continued on page 162

When heat soars...
and flame roars

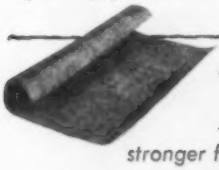
Control them with these Johns-Manville Packing Products



J-M Tadpole Firewall Seals *block passage of flame and combustibles between compartments*

Tadpole Seals installed at the flange between compartments do double duty in modern jet aircraft. (1) In event of fire they confine the flames permitting the pilot to land or bail out. (2) They provide a barrier against leakage of combustible fluids and vapors into "hot" compartments.

J-M Tadpole Seals are made with a specially processed Inconel wire mesh core. This base is covered with asbestos cloth combined with Neoprene, Silicone, Teflon or other materials to assure top performance within each temperature range. All seals comply with the C.A.A. requirements for flame resistance. Style numbers and temperature limits are as follows: 4132-250 F, 137-350 F, 4134-450 F, 4133-500 F, 4161-600 F, 4381-over 600 F.



J-M Bomber Cloth
—new lighter, stronger firewall fabric

#89 Bomber Cloth flexible firewall fabric saves precious pounds. It is the lightest material of its type, yet withstands the most severe C.A.A. tests.

J-M Asbestan Cushions
—for A.N. clips in high temperature installations

Asbestan Cushions give a resilient cushioning with low friction on A.N. clips used for hydraulic lines at temperatures up to 500 F. Specially made of asbestos and Teflon.

J-M Goetze Gaskets Style No. 924 ... *seals hot gases at a wide range of pressures*

Style No. 924 has a steel mesh core, is aluminum jacketed for temperatures to 850 F, stainless steel jacketed for higher temperatures.

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George Keller is responsible for development, design, and testing of hydraulic systems and power servo-mechanisms for the flight control systems of missiles and inhabited aircraft.

He is particularly well known for his work in high temperature hydraulics and has written a number of papers on this subject. He is an active member of the aircraft committees of SAE and is a civilian consultant to the Office of Assistant Secretary of Defense.

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• **The first book** dealing with hydraulic component and system design for high-speed piloted aircraft and missiles, has been written by a leading aircraft engineer. Developed from practical and theoretical material, the book develops many basic equations including those relating pressure gradient, flow-path dimensions, flow rate, velocity, fluid density, and viscosity.

• **Design of system components** including actuators, valves, pumps, accumulators, transmission lines and seals is discussed. Accumulator theory is presented with a detailed example of proper accumulator selection.

• **Hydraulic servo systems** are diagrammed and the transfer functions developed. Fundamentals of transient analysis technique and frequency response method of servo testing are given. The chapter on high temperature hydraulics outlines present progress in fluids, seals, springs, metals, and other critical components, and indicates future developments and techniques.

The advance of industrial hydraulics in servo components and systems makes this book of great value to designers of industrial equipment as well as aircraft engineers.

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AVIATION COMPONENT DATA

long runs at high fluid temperatures.

Available with either a stub shaft or integral electric motor, power ratings are 60 hp for the stub shaft version and 50 hp with the integral motor. Displacement volumes are up to 50 gpm. Pressure lubrication system is built-in. Plunger leakage is returned to the system by a scavenge pump. Integral double-reduction gears are available in several ratios.—*Kobe Inc., Huntington Park, Calif.*

Circle 315 on Reader Service Card

VALVES . . . Check, relief, shuttle and shut-off models for aircraft, missiles and rockets, are illustrated and listed in chart style for easy reference. Also covered are O-ring recommendations, model designation system, material and connection designation. Brochure, 4 pages, *James, Pond & Clark, Inc., Pasadena, Calif.*

Circle 316 on Reader Service Card

Pressurizing Stand . . . 5000 psi air

Air or other dry gases at pressures to 5000 psig can be delivered by this pressurizing stand. Designated Model #KC-1037, output may be used for pressurizing aircraft and missile systems. A four-stage compressor delivers 15 scfm with dryness corresponding to a dewpoint of —65 F or lower. An ICC-3AA 6000-lb cylinder is included for storage.—*Kahn and Co. Inc., Hartford, Conn.*

Circle 317 on Reader Service Card

Useful Literature / continued

HYDRAULIC CYLINDERS . . . compact, precision designed for heavy-duty service at 2000 to 3000 psi, are covered in Bulletin No. H-100 released by Milwaukee Cylinder Co., Cudahy, Wis. Dimension drawings are included for each model, along with a quick-reference dimension chart, and a table of bore and rod diameters. An additional feature of the bulletin is an interchangeability chart giving manufacturers model numbers.

Circle 258 on Reader Service Card

TEFLON HOSE . . . with reusable fittings is manufactured by Aeroquip Corporation, Jackson, Mich. Industrial Engineering Bulletin IEB-26A describes their No. 2802 Teflon Hose, which was designed for applications requiring lubricity, nonadhesion of sticky or viscous materials, resistance to temperatures of 500 F, chemical inertness, and long wear. Specifications are given in simple, chart form, covering hose, fittings, adapters and assemblies.

Circle 259 on Reader Service Card

MOTORIZED ACTUATOR . . . for relief valve and pump control, is illustrated and described in Bulletin A-102 published by United Hydraulics, Inc., Dayton Ohio. Unit permits control and modulation of 5000-psi hydraulic pressure with 15 watts electric power. Actuator replaces manual adjustment of relief and back pressure valves, variable volume pumps and motors, and permits remote control. Engineering and technical data is given, along with schematic diagrams showing applications.

Circle 260 on Reader Service Card

SILICONE RUBBER . . . for —130 to 500 F service, is produced by Dow Corning Corp., Midland, Mich. Brochure No. 9-106 details the physical properties of Silastic, and advantages of its use in a wide variety of mechanical parts. Resistance to heat, cold, weathering, ozone, moisture, oils and chemicals are discussed in turn, and illustrated with graphs, tables, and field applications. Material has a wide range of usefulness, including automotive transmissions and jet engines.

Circle 261 on Reader Service Card

Continued on next page

Buying component parts from one supplier can save a lot of time and trouble . . . less correspondence, a single responsibility, coordinated shipments are only a few of the many advantages. H-P-M's complete line of pumps, power units, valves, cylinders and system accessories can become your standard. This complete service plus H-P-M's experience background in the design and building of hydraulic systems can be a really major "assist" when needed. Write today for a complete catalog and get the facts on single source savings. Ask for Bulletin 1101.

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HYDRAULIC POWER DIVISION

THE HYDRAULIC PRESS MFG. CO.

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1877—1957

Circle 81 on Reader Service Card

On to Chicago...

The October Issue of APPLIED HYDRAULICS will have complete, exclusive program coverage . . . with abstracts of papers . . . on the 13th Annual National Conference on Industrial Hydraulics being held October 17, 18, Hotel Sherman, Chicago. It will also feature articles winning the 3 Top Prize Awards in the 5th Annual Contest sponsored by APPLIED HYDRAULICS. Don't miss it.

OCTOBER ISSUE

Applied Hydraulics

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This special issue means heightened interest for your sales message. Forms close September 5th . . . regular space rates apply . . . order your advertising space today!

Useful Literature

continued

TEFLON & ASBESTOS PACKINGS . . . produced by Johns-Manville under the name Chempac, are described in their 16-page booklet. Fluid power engineers will be interested in the information given on the various types of packings and gaskets, which are completely illustrated, with necessary technical information given. Also included are a chart giving the properties of Teflon obtained from various tests, and a table of gasket types, forms and sizes, and the service and equipment for which they are recommended. Packings and gaskets are available in the usual types of V-rings, A-cups, U-cups and hat gaskets, as well as Clipper seals, cup and cone packing, valve seats, O-rings and miscellaneous shapes. Chempac is also available in asbestos-teflon, and pure teflon tapes and sheets.

Circle 262 on Reader Service Card

PROPER OIL TO USE . . . for fluid power systems, is covered in 16-page, illustrated Bulletin 900-002A, issued by The Oilgear Co., Milwaukee. Booklet provides information of interest to designers and engineers with problems in fluid selection and maintenance. Section on oil selection covers the need for high quality, what the oil must do and not do, physical tests, SAE numbers, viscosity requirements, pour point, and an explanation of additives. The section on maintenance recommendations is illustrated with cross-sectioned pumps to show the points covered, and discusses oil level, pressure and temperature, care of the oil filter, elimination of foam, oil changes and draining procedure. Under the section on outdoor operation, helpful information is given on starting, conditions of extreme cold, rust inhibitors and filters.

Circle 263 on Reader Service Card

TUBE & PIPE BENDING . . . Engineers, designers and others in the fluid power field involved in the fabrication of pipe and tubing will be interested in Bulletin TDC-187, released by the Tubular Products Division of The Babcock & Wilcox Co., Beaver Falls, Pa. This 6-page folder describes the various methods of bending pipe and tubing and supplies helpful hints which will overcome many bending problems. Information given includes: what happens when a steel tube is bent, bending without mandrel or filler, bending with filler, with mandrel, press bending, roll bending, stationary-die form bending, revolving-die bending, and wrinkle bending. Drawings illustrate the various methods used.

Circle 264 on Reader Service Card

BIBLIOGRAPHY of FLUID POWER . . . Engineers and designers should find this a very valuable guide to literature in the fluid power field. Compiled by the Education Committee of the National Fluid Power Association, the book represents a valuable cross-section of the best literature available on fluid power. In general, only books have been included, due to time and space limitations. Books devoting only a few sections to fluid power have not been included. This Bibliography is presented in loose-leaf form so future additions may be conveniently included. The material is broken down into three major divisions: Fluid Power, Hydraulics, and Pneumatics. These are further divided into applied, basic theory, control, data and tables, advanced theory, and general. An alphabetical subject index assists in locating various subjects referred to in volumes listed. A cross-index is provided in an author-title index. Copies of the Bibliography are available, at $2 each, from the National Fluid Power Association, 1618 Orrington Ave., Evanston, Ill.

THREAD PROTECTORS . . . of unbreakable, flexible plastic, are illustrated and described in a bulletin released by Super Oil Seals & Gaskets Ltd, Birmingham, England. These caps and plugs protect internal and external threads on tubes, hose fittings, valves, hydrau-

lic and pneumatic components, and machined parts. Foreign matter can be sealed out during manufacture, storage and transport. Units for various types of service are illustrated, with charts giving standard sizes for male and female fittings.

Circle 265 on Reader Service Card

BRASS HOSE FITTINGS . . . for fluid power service, are manufactured by Le-Hi Division of Hose Accessories Co., Philadelphia. Bulletin No. 140 describes and illustrates brass hose fittings for low and medium pressure service.

Circle 266 on Reader Service Card

LIMIT SWITCHES . . . produced by Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill., are illustrated and described in available data sheets. Explosion-proof switches are covered in Data Sheet 129. An adjustable mounting bracket for basic switches is described in Sheet 131. Data sheet 132 discusses the impact actuated, or inertia switch. Toggle switches, with the pull-to-unlock feature, are shown in Sheet 134.

Circle 267 on Reader Service Card

QUAD RING SEALS . . . Full information on these four-lipped seals is contained in a 12-page reference booklet published by Minnesota Rubber & Gasket Co., Minneapolis. Booklet is illustrated with schematic drawing and specification charts as reference for product design and development. In addition to general information on Quad Ring design, data is given on design considerations for reciprocal and rotary applications, with an engineering check list for packing installation and material requirements. Illustrated case histories give solutions to problems of reciprocal, rotary and pressure sealing.

Circle 268 on Reader Service Card

GAGE ISOLATOR . . . designed to protect fluid pressure gages from damage due to surges in hydraulic circuits, is described in a bulletin issued by Sarasota Precision Products, Inc., Sarasota, Florida. Unit is a simple, spring-loaded device which is installed in any gage line. The device is normally closed, isolating the gage, but by depressing a push button, the gage line is opened. Releasing the push button closes the gage line and drains the gage to the reservoir.

Circle 269 on Reader Service Card

Continued on next page

When you buy flexible connections . . .

get the benefit solid experience provides

"Know-How" makes the big difference! The knowledge gained through half-a-century of continuous Research and Development is built into every FLEXON assembly . . . assuring you a product that gives superior service.

For your rubber, synthetic or metal hose requirements, find out what a difference Flexonics craftsmanship can make to you in fluid power or other applications. For specific recommendations send an outline of your requirements.

H-8

Since 1902
FIRST IN FLUID FLOW

Flexonics Corporation
HOSE DIVISION
1385 S. THIRD AVENUE, MAYWOOD, ILLINOIS

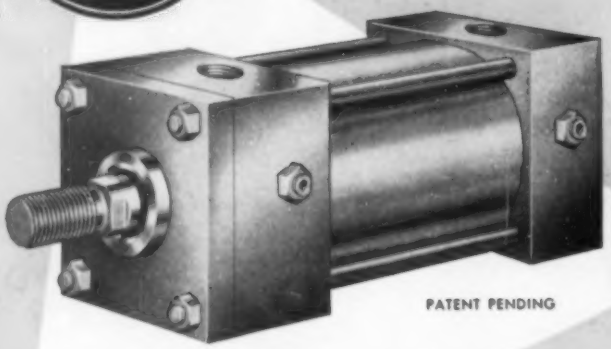
Manufacturers of hose, expansion joints, metallic bellows and aircraft components.

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ont.

Circle 54 on Reader Service Card

FOR AUTOMATION

S-P CYLINDERS



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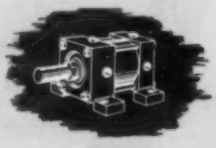
top performance–longest life

All S-P cylinders are engineered throughout for high speed, efficient operation. Piston rods are heat treated and hard chrome plated to resist scoring. Bronze cartridges with extra long bearing surfaces are easily removable for quick servicing of rod seals and wipers. End plates are rolled steel. All S-P cylinders are built to JIC standards.

S-P STANDARD AIR CYLINDERS have brass tubes to eliminate corrosion. Cushions float on O-rings for maximum cushioning. Eleven bore sizes, 1½" — 14". 21 mounting types. Readily modified for oil or water. Send for Catalog No. 110.

S-P HEAVY DUTY AIR CYLINDERS for automation and other severe applications. Double porting for extreme high speeds. Heavy wall seamless steel tube. Nine bore sizes, 1½" — 8". Five mounting types. Approved and used by two major automobile manufacturers. Send for Catalog No. 109-A.



S-P HIGH PRESSURE HYDRAULIC CYLINDERS have seamless steel tube. Special locking mechanism eliminates tie rods. Designed for 2,000 psi. Eleven models in 11 sizes. Send for Catalog No. 104.

Step up production with S-P cylinders. Representatives in principal cities. Prompt deliveries. Order catalog by number shown above. The S-P Manufacturing Corporation, 30201 Aurora Rd., Solon, Ohio. *In greater Cleveland.*

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THE S-P MANUFACTURING CORP.

SOLON, OHIO • *IN GREATER CLEVELAND*

ESTABLISHED 1916 — A BASSETT COMPANY

NON-ROTATING AIR AND HYDRAULIC CYLINDERS • ROTATING AIR AND HYDRAULIC CYLINDERS
POWER CHUCKS • COLLET AND DRILL PRESS CHUCKS • AIR PISTONS, VALVES, ACCESSORIES

Useful Literature / continued

PORTABLE FILTERING . . . is provided by the Filter Buggy manufactured by Schroeder Brothers, Pittsburgh. Bulletin 3M855 illustrates this unit, which rolls on rubber-tired wheels right to the job. Standard unit has no motors or pumps and uses machine power. Available with pump and motor mounted. Connections are made by quick disconnects. Unit is built for working pressures up to 250 psi and tested to 500 psi. A 200-psi relief valve protects against improper connection.

Circle 270 on Reader Service Card

STOP CLOCK . . . accurate to 1/100 sec. is described in Bulletin PB-691 released by Cramer Controls Corp., Centerbrook, Conn. Unit is an industrial, laboratory, or military electrical reset time totalizer. Folder contains detailed description of material, rating and construction specifications, and an exploded view shows design principles. All operating features are explained in detail, with suggestions of specific application possibilities.

Circle 271 on Reader Service Card

SAFETY FOOT GUARD . . . manufactured by Versa Products Co., Inc., Brooklyn, is covered in Bulletin No. 657. Unit gives positive protection against accidental tripping of the valve, and shields the valve mechanism against injury. One size adapts to fit all sizes and types of pedal actuated valves. May be bolted down for permanent installation, or can be used unbolted and moved about to location convenient for operator. Also acts as a base for valves that can not be secured to floor or equipment.

Circle 272 on Reader Service Card

ELBOW FITTINGS . . . and assemblies designed to simplify installation in confined spaces, are illustrated and described in Bulletin IEB 27 issued by Aeroquip Corp., Jackson, Mich. Various types are illustrated on a handy reference chart giving complete engineering data and specifications. Units eliminate the need for combinations of standard elbows and adapters plus straight hose fittings.

Circle 273 on Reader Service Card

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1	18	35	52	69	86	103	120	137	154	171	188	205	222	239	256	273	290	307	324
2	19	36	53	70	87	104	121	138	155	172	189	206	223	240	257	274	291	308	325
3	20	37	54	71	88	105	122	139	156	173	190	207	224	241	258	275	292	309	326
4	21	38	55	72	89	106	123	140	157	174	191	208	225	242	259	276	293	310	327
5	22	39	56	73	90	107	124	141	158	175	192	209	226	243	260	277	294	311	328
6	23	40	57	74	91	108	125	142	159	176	193	210	227	244	261	278	295	312	329
7	24	41	58	75	92	109	126	143	160	177	194	211	228	245	262	279	296	313	330
8	25	42	59	76	93	110	127	144	161	178	195	212	229	246	263	280	297	314	331
9	26	43	60	77	94	111	128	145	162	179	196	213	230	247	264	281	298	315	332
10	27	44	61	78	95	112	129	146	163	180	197	214	231	248	265	282	299	316	333
11	28	45	62	79	96	113	130	147	164	181	198	215	232	249	266	283	300	317	334
12	29	46	63	80	97	114	131	148	165	182	199	216	233	250	267	284	301	318	335
13	30	47	64	81	98	115	132	149	166	183	200	217	234	251	268	285	302	319	336
14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303	320	33.
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304	321	338
16	33	50	67	84	101	118	135	152	169	186	203	220	237	254	271	288	305	322	339
17	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306	323	340

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4	21	38	55	72	89	106	123	140	157	174	191	208	225	242	259	276	293	310	327
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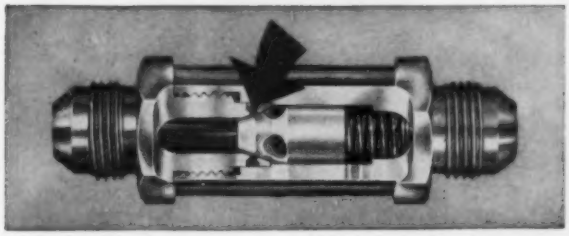
6	23	40	57	74	91	108	125	142	159	176	193	210	227	244	261	278	295	312	329
7	24	41	58	75	92	109	126	143	160	177	194	211	228	245	262	279	296	313	330
8	25	42	59	76	93	110	127	144	161	178	195	212	229	246	263	280	297	314	331
9	26	43	60	77	94	111	128	145	162	179	196	213	230	247	264	281	298	315	332
10	27	44	61	78	95	112	129	146	163	180	197	214	231	248	265	282	299	316	333
11	28	45	62	79	96	113	130	147	164	181	198	215	232	249	266	283	300	317	334
12	29	46	63	80	97	114	131	148	165	182	199	216	233	250	267	284	301	318	335
13	30	47	64	81	98	115	132	149	166	183	200	217	234	251	268	285	302	319	336
14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303	320	337
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304	321	338
16	33	50	67	84	101	118	135	152	169	186	203	220	237	254	271	288	305	322	339
17	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306	323	340

Circle 87 on Reader Service Card

Simple, Secure . . . Leak-Tight!

The FLEXIBLE SEAL SEAT*



Responsive action of the soft O-ring seal provides absolute leak-tightness. Instantly compresses to seal internal and external pressures. Draws harmlessly around dirt particles. No costly precision parts; no extra end seals. Stocked in 6 standard Dryseal pipe and JIC tube sizes; 12 connection combinations. Write for data sheet.

KEPNER PRODUCTS COMPANY
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Kep-O-seal

HYDRAULIC & PNEUMATIC
CHECK VALVES

* PATENT APPLIED FOR

Circle 5 on Reader Service Card

AIR-MITE

HIGH PRODUCTION AIR PRESS
with more Quality Features

★ Solid Steel Column. Greater strength and rigidity.
★ Brass cylinder, aluminum end castings, Hy-Car piston cups.
★ Accurately ground table.
★ Fast set-up and stroke adjustment.

You don't have to "baby" an AIR-MITE Press because they're ruggedly built to stand the gaff of production work. From the tip of their solid steel column to the heavy base, they're every inch a workhorse tool. Feature-for-feature, you can't buy a better, more economical operating press than an AIR-MITE.

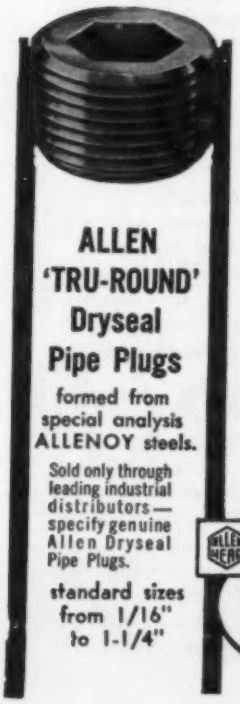
Special adaptations available. Write us your needs.

1 Ton Capacity
$89.95
F.O.B. Chicago

New 3 Way Control Valve. For safer, more efficient press work, use AIR-MITE Control Valves. Connected in parallel and positioned on either side of an air press, they provide a safe, instantaneous press operating control. Operator must depress both handles to actuate press . . . keeps attention on work-piece, hands out of the way. For pressures up to 160 p.s.i.

AIR-MITE Devices, Inc.
4401 W. KINZIE ST., CHICAGO, ILLINOIS

3000 psi won't get by the threads of Allen ⬡ Dryseals!



ALLEN 'TRU-ROUND' Dryseal Pipe Plugs
formed from special analysis ALLENOY steels.

Sold only through leading industrial distributors — specify genuine Allen Dryseal Pipe Plugs.

standard sizes from 1/16" to 1-1/4"

Here's the dependable, metal-to-metal seal you need for hydraulic systems . . . for transmission, control, and automated mechanisms where pressures run high. The N.P.T.F. threads of Allen ⬡ Dryseal Pipe Plugs are smooth, burnished, and burr-free — do their job without any help from sealing compounds. Allen's unique "pressur-forming" process assures the highest degree of precision threading and dimensional accuracy. What's more, Allen ⬡ Dryseals are precisely round at root, pitch and crest, with taper held to extremely close tolerances.

Allen engineers will gladly help you to harness your hydraulic pressures. Just write.

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Send for this
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showing how

CROWN
HYDRA-TROL
Remote Control

- Has positive stroke in both directions.
- Does not depend on spring return or outside power sources.
- Immediate synchronization of system in either direction.
- Is a self-contained hydraulic system for positive positioning of remotely-located levers, shafts, and other equipment.
- Valuable in controlling hydraulic valves, winches, throttles, slitting machines, butterfly valves, etc.

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FIRE-RESISTANT HYDRAULIC FLUIDS

PART 4 – Pure Phosphate Ester

• By W. D. Matthews

PREVENTION of fire in industrial plants today is not just a safety measure. It is an economic consideration as realistic as raw material cost reduction or increased output, and can affect the earnings statement just as profoundly.

• **Types**—Four basic types of fire-resistant hydraulic fluids are available to industry today:

1. Pure phosphate ester
2. Phosphate ester based
3. Water and glycol mixture
4. Water and oil emulsion

These cannot properly be compared on an overall basis, but must be individually examined according to their conformance with the many criteria for suitable hydraulic fluid. Some standards might be:

1. Fire resistance
2. Lubricity
3. Ease of handling, toxicity, etc.
4. Installation preparation
5. Effect on machinery
6. Effect on packings, seals, gaskets
7. Ability to reclaim and reuse
8. Stability
9. Cost

There are many other ways to evaluate these fluids, which further complicates the issue. Only a careful study of each fluid, with intended application in mind, allows the hydraulic engineer to make a satisfactory choice.

• **Pure Phosphate esters**—These are known as Cellulubes, made by the Chemical Division of Celanese Corporation of America. They are available in six controlled viscosities ranging from 90 SSU to 1000 SSU at 100 F. Thus a fluid can be selected with viscosity to match, or closely approximate, just about any grade of hydraulic oil now in use. The viscosities of these fluids are not achieved with additives or thickeners, but by constructing molecules of the same general classification which exhibit varying physical properties.

These six different fluids are essentially the same chemically, and physically, except for viscosity. They possess good mechanical and chemical stability, and are more resistant to oxidation than natural petroleum products.

• **Lubrication**—Since the phosphate esters have polar groups, their molecular structures align themselves along a metallic surface creating a strong adhesive bond between the fluid and the metal. This contributes to the lubricating value of the fluid down to boundary conditions under extreme pressures. A cross section of industrial experience in almost every type of equipment shows the phosphate esters have essentially the same lubricating life as premium-grade petroleum products.

W. D. MATTHEWS, *Chemical Div., Celanese Corporation of America.*

PACKAGED *Oil-Free* COMPRESSED AIR

MOTOR
Ball bearings permanently grease packed—no re-oiling.
PORTABLE
Compact, light in weight, insulated handle.
INTEGRATED AFTERCOOLER, PULSATION CHAMBER, MOISTURE SEPARATOR
Provides cooler, drier air at smooth, uniform pressure.
AUTOMOTIVE TYPE FAN
Assures low temperature operation for higher efficiency, longer life.
SAFETY VALVE
(Not visible)
Provides constant bleed-off at maximum pressure. Also acts as automatic moisture drain.
GRAPHITE PISTON RINGS AND SKIRTS
Special composition needs no lubrication. Self-sealing piston ring joint reduces blow-by.
DRY VALVE CONSTRUCTION
Positive-sealing without oil. Self-cleaning—no rubbing parts.

AIR WHERE YOU WANT IT... COMPLETELY OIL-FREE... COOLER... DRIER!

Expensive lubrication maintenance completely eliminated!

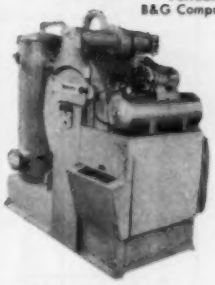
Where *clean* compressed air is essential, the B&G Oil-less Compressor provides the answer in a complete line of portable, tank-mounted and tankless models.

There is no oil required in this new design unit! Motor and compressor are permanently grease packed... graphite piston rings and skirts operate for years without destroying the mirror-finish of the cylinder walls. Since the cylinders are not lubricated, oil-free air is delivered at all times without need for an oil separator.

B&G Compressors are really *smooth!* Modern design large bore, short stroke, horizontally opposed pistons provide better balance and vibrationless operation. Compactness and light weight adapt them ideally to either portable or built-in applications. In every detail these units are designed to deliver *maximum air per horse power!*

For complete information on B&G Oil-less Compressors and Vacuum Pumps, send for Catalog GO-1156.

Portable B&G Compressor



B&G Oil-less Air Compressor as integral part of dry cleaning machine

Oil-less AIR COMPRESSORS

BELL & GOSSETT

COMPANY

Dept. EY-66, Morton Grove, Illinois

MAKERS OF HEATING AND COOLING SPECIALTIES, PUMPS, HEAT EXCHANGERS

FIRE-RESISTANT HYDRAULIC FLUIDS

• **Fire-resistance**—It should be remembered that fire-resistant does not mean non-flammable. Every fire-resistant fluid on the market today will burn under certain conditions. However, each one has the ability to resist fire to varying degrees, depending upon its composition and the circumstances of its exposure to fire or heat.

• **Tests**—Dozens of tests are used by various laboratories to determine relative fire-resistance. The majority of them stem from the technology and experience of the petroleum industry. This particular subject is now under investigation by the A.S.T.M.

A spray of atomized phosphate ester fluid at 1000 psi was impinged on a metal plate, heated to 1200 F, in the presence of flame. There was no ignition and no flash back. With the same test on a 1400 F surface, there was intermittent ignition, but still no flash back.

These tests do not always reflect the exact conditions encountered in a busy plant, and the figures should be used only as a guide for comparison.

• **Hazards**—In operation of hydraulic equipment, the largest percentage of accidents occur from the rupture of some vessel, line, or joint, releasing hydraulic fluid under high pressure. Such a break can dribble or spray fluid over a wide area. Spurts of 50 to 60 feet are not uncommon. The fluid may be exposed to hot metal surfaces, open flames from gas burners and torches, molten metals in die casting, electrical arcs or sparks, and a variety of other ignition sources. Therefore, reaction of the fluid to these different circumstances is important to the user.

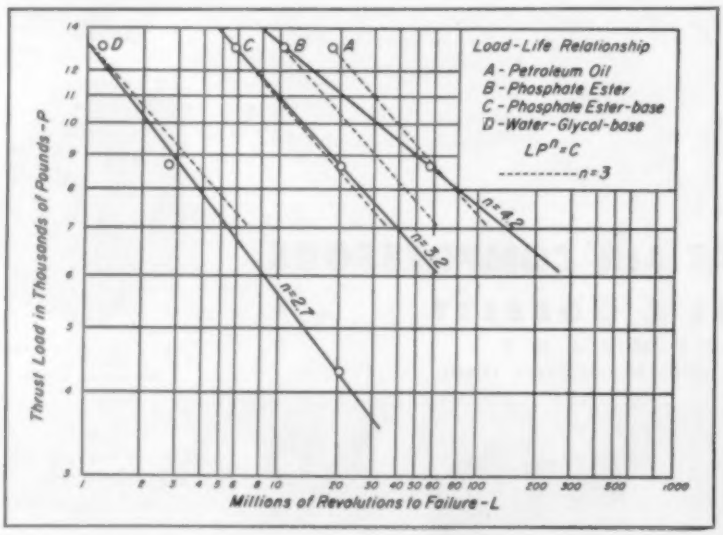
• **Properties**—The phosphate ester fluids have the following properties which may vary slightly according to viscosity:

Flash point		455 F
Fire point		685 F
Auto-ignition temp.	over	1175 F
SAE-AMS Hot Manifold Test		1400 F
Molten metal ignition test (flood)		1700 F
Molten metal ignition test (drip)		1500 F

An important feature of the phosphate esters is that they do not flash back from ignition source to the point of system rupture. Some of the danger in the use of flammable petroleum products is their ability to support and distribute combustion when ignited. This gives rise to flash back, and continuance of the fire until the fuel is consumed. The phosphate ester fluids will burn only at the point of ignition, and then only when the fluid temperature at that point is maintained well above its fire point limit. Thus combustion is confined and spread of fire is prevented.

Fire-resistant properties of phosphate ester fluids are inherent in their chemical nature, and are not affected by continued use at temperatures considerably above the normal operating ranges. Since they contain no additives or aqueous components, no fluid maintenance is required to assure continuing fire-resistance.

• **Toxicity**—Recently, information has been developed on this subject by producers, industrial



DIFFERENCES shown in effects of fire-resistant hydraulic fluids on model life of angular contact ball bearings were obtained from work done by H. V. Cordiana, E. P. Cochran, Jr., and R. J. Wolfe of the N.Y. Naval Shipyard.

Circle 67 on Reader Service Card

Announcing—

A NEW GRESEN VALVE

With FLOAT Position

GRESEN HYDRAULICS

A Two Spool Directional Control With Float

FEATURES: Detent in Float Position—Self Centering From Power Positions—Fully Balanced—Relief Valve Has Replaceable Hardened Seat—Tripod Mounting Feet—Smooth Positive Throttling Action—Hardened and Chrome Plated Spools.

SPECIFICATIONS: Capacity 20 GPM (at 20 Ft/seconds)—Maximum Pressure 1500 PSI—Parallel Application—Shipping Weight 22-1/2 Lbs.

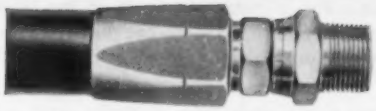
Write for literature

GRESEN MANUFACTURING CO.

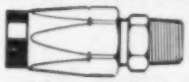
628 Colfax Ave. N. Dept. H-97 Minneapolis 11, Minn.

LEAK-PROOF!

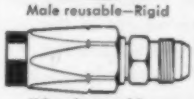
REQUIRE NO SPECIAL ASSEMBLY TOOLS



NEW HYDRALINK MALE SWIVEL REUSABLE COUPLING



Male reusable—Rigid



JIC male reusable

JIC female reusable—Swivel

90° Swivel elbow

Permanent coupling assemblies

Hydralink couplings, both permanent and reusable types, are quality units conforming design-wise with national and JIC standards but going a step farther in providing simplified installation and positive leak-proof seals that exceed the demands of peak pressure loads. The new Hydralink catalog is easy to read and helps you select the units you want without cross reference and guessing. Write for it today.

Distributor and Agent territories still available.

HYDRALINK CORPORATION

1009 E. 10 Mile Rd.
Hazel Park, Mich.

YOU NAME THE APPLICATION... ASHCROFT GAUGES

MEET *EVERY* REQUIREMENT

For more than 100 years the name Ashcroft has stood for the most advanced pressure gauge research, design and engineering. By anticipating the constantly changing and expanding needs of all industrial users, we have combined in Ashcroft Gauges the highest degree of accuracy and long-life service for every type of installation. You can select dial sizes ranging from 2″ through 24″ . . . pressures from 30″ vacuum or a few ounces up to 100,000 psi . . . materials that meet all service demands.

There are three classes of Ashcroft Gauges. Each class has functional characteristics suited to the applications for which it is recommended.

DURAGAUGES. The finest pressure gauges built. Highest accuracy and durability make them ideal for the toughest services. They save many times their original cost in replacements and repairs.

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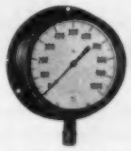
Among the many Ashcroft Gauges are Maxisafe®, pneumatic receiver, recording, chemical and special application gauges, plus a variety of gauge testers. Get all the facts. Learn why Ashcroft Gauges are the best investment you can make. *Write for Catalog 300.*

Quality Gauge No. 1010 for general applications.



Quality Gauge No. 1056 for hydraulic presses.

Quality Gauge No. 1000 for small equipment.

Special Purpose Gauge No. 1009. Heavy-geared.

Vibration-Resistant Gauge No. 1122. Heavy-duty gearless.

Duplex Gauge No. 1038 A. Indicates two pressures on dial.

ASHCROFT GAUGES

A product of

MANNING, MAXWELL & MOORE, INC.

250 East Main Street
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PNEUMATICS SHEFFER HYDRAULICS

HYDRAULIC CYLINDERS

C4 H Series

2000-3000 psi
All Steel Construction
Meets or Exceeds J.I.C.
12 Bore Sizes—1⅛—12
Removable Rod Cartridge
Finest of the "Interchangeables"

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THE SHEFFER CORP.

CINCINNATI 15, OHIO

MOST COMPLETE LINE OF CYLINDERS IN THE INDUSTRY

SOME TERRITORIES OPEN

"Wipe out" PACKING FAILURES WITH Seal-Guard METALLIC ROD WIPERS

Self-adjusting, easy to install, Seal-Guard's knife-like bronze rings "wipe off" all dirt and grime, will not mar the rod, are oil and heat resistant and friction-free.

HOW SEAL-GUARD WORKS

1. Twin wiper rings are mounted on rod with notches staggered.
2. Cushion ring is compressed on assembly exerting constant inward pressure keeping ring in constant contact with rod.
3. Harmful substances are completely cleared by scraper action.

Seal-Guards are available to fit rod diameters from ¼ to 24 inches. Other sizes by special order.

WRITE FOR DESCRIPTIVE LITERATURE.

HYDRAULIC ACCESSORIES CO.
24301 Hoover Rd. Van Dyke, Mich.

FIRE-RESISTANT HYDRAULIC FLUIDS

toxicologists, and various medical groups of the U. S. Government. While some questions remain to be resolved, enough is known for a realistic appraisal of their nature for industrial applications.

Users are cautioned not to take these products internally. Beyond this, however, standard plant hygienic routine appears adequate to safeguard workers against harmful effects which could be attributed to phosphate esters. These same fluids, purchased by the U. S. Navy according to Mil Spec H-19457, are subject to toxicity approval by the Navy, which has devoted much time and effort to the study of this matter.

The pure phosphate ester fluids contain no chlorinated hydrocarbons, eliminating the possibility of chlorine bearing fumes.

• **Corrosion**—Phosphate esters are non-corrosive by nature and may be used with any of the metals commonly used in the manufacture of hydraulic equipment. They have no deleterious effect on zinc or cadmium plated parts such as strainers or fittings. Due to their non-corrosiveness and their extremely low vapor pressure, these fluids present no vapor phase corrosion problems and require no inhibitor to control this action.

• **Foaming**—Excessive foaming, or a tendency to retain foam, can be a vital factor in reducing pump life and causing erratic cycle operation. Proper pressures will not be maintained throughout the system and the lubrication of the pump may break down sufficiently to damage it permanently within just a few minutes. As tested in the laboratory according to ASTM D-892, the phosphate ester fluids are classified as non-foaming.

• **Fluid maintenance**—Having no additives or aqueous components, phosphate esters require no maintenance other than normal filtration. Any standard type of filter may be used, including the activated clay or Fuller's earth type, metallic disc, cellulosic pack, etc. The non-additive nature of the material allows for minimum particle size filtration without fear of removing any added ingredient.

In general, most lubrication engineers schedule these fluids for replacement at approximately the same intervals as for petroleum oils.

• **Equipment conversion**—Conversion of equipment now using other hydraulic fluids to phosphate ester fluids is important, but not burdensome. Assuming that petroleum oil is in the circuit, a general method of procedure would follow these lines:

Drain the system as thoroughly as possible, blowing down lines and valves where practicable. Since the phosphate ester fluid will mix with petroleum, any oil remaining will mix without precipitation

or separation. However, petroleum as a contaminant will reduce the fire-resistance, and this should be kept down to 3 to 5%.

• **Remove paint**—Interior surfaces of sumps, reservoirs, etc., which are painted, should be cleaned and the paint removed. The phosphate ester will lift or soften most common paints, and this could lead to clogging of valves, etc. Since vapor phase corrosion is not a problem, interior surfaces would not require painting except in unusual circumstances. Special paints, resistant to these fluids, are available.

• **Replace seals**—Packings, seals, gaskets, etc., should be of materials compatible with phosphate ester fluids. These are generally of the Butyl Rubber, Silicone Rubber, and Teflon and specialty products recommended by individual manufacturers. Ordinary elastomers, neoprene, Buna types, etc., will generally swell in phosphate ester fluids, and should be replaced at time of conversion. However, only those gaskets, O-rings, etc., that are in dynamic use, where a moving action is involved, need be replaced at this time. Static seals may be left intact and need only be changed when the equipment is dismantled for repair or regular maintenance.

More on Fire-Resistant Fluids

This is the fourth of a series of basic articles on the different hydraulic fluids currently available.

The first article, published in April, discussed Emulsion Fluids. In June we ran the second article on Aqueous Base Types. The third appeared in our August issue, covering Phosphate Ester Base Types. Subsequent articles will be:

Change-Over Practice, by Charles R. Schmitt, Manager, Lubrication Dept., E. F. Houghton & Co.

Concluding article in the series will be: Safety & Use Factors, by Lawrence Jackson, Plant Supt., Withrow Die Casting Co., N. Hollywood, Calif.

• **Pipe joints**—Where piping joints have been disturbed during conversion, it is advisable to reassemble them using a pipe-joint compound resistant to these fluids. Several types are available.

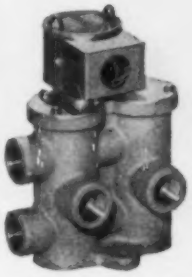
• **Filter**—After the system has been re-assembled and filled with the new fluid, a filter should be put in the line, (if not already provided), for the first day or two of operation. This will collect any foreign particles dislodged during the work and any bits of paint, etc., which the phosphate ester might have removed.

Beyond these few steps, no further maintenance is required and regular plant routine can be adapted to these units. ▼▼▼

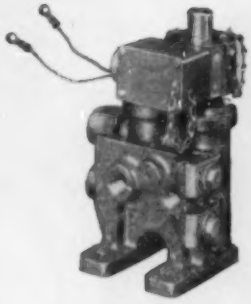
BY A MERE COIL CHANGE

Crescent® Valves are adaptable to

ANY VOLTAGE



Standard 4-Way



J.I.C. Type 4-Way

Standard 3-Way

® 4-Way and 3-Way Solenoid operated, pilot controlled valves for Air, Water and light oil to 150 P.S.I., products of Crescent Valve Co.

NO COIL BURNOUT

because a generous power margin, short solenoid travel and pilot operation combine to prevent overheating and overloading. Note that these valves are accepted and used in automotive plants where assembly line production does not permit coil or valve failure.

LONG SERVICE LIFE

Main valve design is aimed at extremely long trouble free service. Resilient seats are tight sealing and are not affected or damaged by dirt or grit because they are of a self scavenging design. Witness their superior performance in such severe service as operating hopper doors on cement batching equipment and in other dusty environment.

INTERCHANGEABILITY

Solenoids and pilot sections are interchangeable from one valve size to another, minimizing spare parts requirements. Adaptation to any practical voltage is achieved by a simple coil change.

Speed of response, speed of installation and dependable leakproof operation year in and year out are responsible for the increasing switch to Crescent valves on production machinery where time is money.

For complete data write for Catalog 6-C.

BARKSDALE VALVES

5125 Alcoa Avenue, Los Angeles 58, California

Precise, yet rugged, too

Like Old Reliable here, MAC valves are proved performers. They're designed for dependability . . . precision built to operate *exactly*—cycle after cycle. That's because we demand much more from our valves than just ordinary duty. MAC spools, for instance, are engineered to withstand at least 75 times actual use load. MAC springs are "shot-peened"—a process that lengthens life by more than 1000% and virtually eliminates spring failure.

So it goes—*right down through the assembly line.* We build in the important "extras" that make the difference. And that's why you can expect more from a MAC valve—in performance, dependability and long life. Contact a representative listed at right. His know-how can help you with any air valve application.

MECHANICAL AIR CONTROLS, INC.
10030 Capital, Oak Park, Detroit 37, Michigan

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MECHANICAL AIR CONTROLS, INC.
DETROIT 37, MICHIGAN
MAC

New Products continued

DIFFERENTIAL SWITCH

. . . uses metal diaphragm

Designation: Model 2273

Features: Unit comes in two classes for sensing pressure differences from 15-in. water below atmospheric pressure to 80-in. of water above. Fixed actuation value ranges from

.2-in. to 2-in. water, depending on the switch setting. Reference pressure must be air or inert gas and variable pressure may be liquid or gas. Switch will actuate an electric circuit on an increase or decrease of a predetermined pressure difference. External adjustment screw is tamper-proof, and switch is not sensitive to jarring or vibration and will operate in any position. Unit contains U.L. approved SPDT snap action switching element rated for ac and dc, and has a splashproof housing.

Barksdale Valves
Los Angeles, Calif.

Circle 191 on Reader Service Card

PUMP MOTOR UNITS

. . . save space, time

Features: These are positive displacement pump and driving motor

units for singular plant applications which do not warrant custom design. They can be used in varying combinations for hydraulic service. Units are close-coupled with the pump mounted on the motor. This eliminates coupling, adapter or base. Units provide savings in space, reduced weight, fewer components and less assembly time. The rotary, positive displacement pumps in these driving units range from 20 to 300 gph, and pressures to 1500 psi. Combinations include ¼-hp motors and larger.

Tuthill Pump Co.
Chicago, Ill.

Circle 192 on Reader Service Card

POWER UNIT

. . . features demand system

Features: Electric-hydraulic power unit is designed for varied use, low cost, simple operation and maintenance, and ease of transportation. Unit features a demand system with

constant pressures to 3000 psi. System pressure is accurately adjustable to 25 psi, the system is filtered, and the unit is powered by a high-speed, high-efficiency gear pump.

Specifications: 110-volt ac or dc. Standard equipment includes dial pressure gauge, hydraulic hoses, electrical cable, automatic pressure control, two accumulators, lift ring, accessory compartment, hose and cable spool, filter-vented filler cap and reservoir. Dimensions: 16¼ x 14¼ x 23-in. high; weight 85 lbs; test connections ¼-in. pressure and return; one gallon reservoir; ½ hp, 115v, 4.8 amp., 10,000 rpm motor.

Hi-Shear Rivet Tool Co.
Torrance, Calif.

Circle 193 on Reader Service Card

Continued on next page

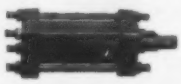
Circle 42 on Reader Service Card

RUGGED, HEAVY-DUTY
HYDRAULIC CYLINDERS

Attention: O. E. M.
Prompt delivery on any quantity . . . high quality . . . low cost!

Built-In Mechanical Stroke Control

Free catalog and engineering survey, no obligation.



WRITE . . . PHONE . . . WIRE

CROSS MFG. CO.

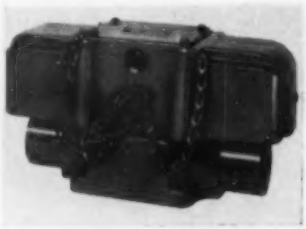
LEWIS ■ PHONE 86 ■ KANSAS

New Products continued

FOUR-WAY VALVES

. . . offer space savings

Features: Unit features use of smaller solenoids. Same solenoids can be used throughout circuit where different sized valves are used. It is even possible to use the valve as the pilot section of some 1¼ and 1½-in. valves. Surges in



tank line will not effect valve operation. Drain line surges are eliminated by an exclusive seal drain. Smoother shifting is featured through control of speed of spool traverse. Valves may be externally piloted.

Specifications: Three model types are available: double-solenoid, no-spring; single-solenoid, spring-offset; and double solenoid, spring-centered. Valves are shorter than direct solenoid valves, but flow capacity is greater. Rated capacity is 8 gpm and maximum operating pressure is 2000 psi. Eleven spool modifications are available, including tandem type.

Double A Products Co.
Manchester, Mich.

Circle 194 on Reader Service Card

PUSHBUTTON BOXES

. . . are oil-tight

Designation: Extra deep, Slim, and Pendent.

Specifications: These new type units are designed to receive any regular make of oil-tight pushbutton control unit. Extra Deep model is 4¾-in. deep, giving space for wiring stacked or tandem units.

gagegard gagega gard gagegard ga

PROTECT PRESSURE-SENSITIVE INSTRUMENTS . . . POSITIVELY

GG gage gard

Seals off gage or manometer connection at any pre-set pressure. Will repeat within 1% of scale. Will release 2% below cut-off point.

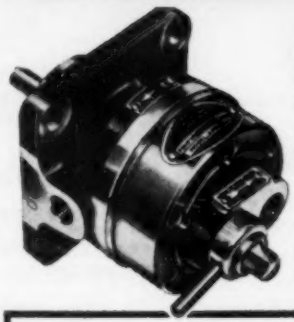
Models available with cutoffs from 20" water to 9000 psig. liquids and gases. Designed to withstand and hold closed against 10,000 psig.

Marine models available.

Write for Bulletin 541-G for full details and prices.

INDUSTRIAL ENGINEERING CORPORATION
525 E. Woodbine, Louisville, Ky.

SAVERY ANNULAR PISTON PUMP



Infinitely variable from maximum output down to zero. Working pressures up to 1500 p.s.i. Fixed delivery models also available.

This compact rotary pump without Gears, Valves, Vanes or Springs is of unique design and simple in construction.

The pump has the following desirable characteristics:

- Volumetric efficiency as high as 99%
- Absolute positive action and steady uniform flow at slow speeds
- No aeration or turbulence of the fluid
- The path of the fluid through the pump is unidirectional and the internals are constantly swept by the fluid
- No idle pockets or passages to cause air locks or allow coagulation
- Completely self-lubricating, ensuring capacity to run for long periods without attention
- Leakproof

U. S. and CANADIAN AGENT
DAVIES BROS., GLADSTONE, NEW JERSEY

Thomas Savery Pumps Ltd., Birmingham, England

Circle 83 on Reader Service Card

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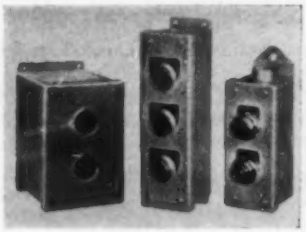
Slim model is 2½-in. square for vertical or horizontal mounting. Pendent model is 2½-in. square and has a conduit hub. This type is suited for controlling overhead cranes. All models have oil-tight



construction, with gasketed covers and external mounting feet. Cover screws are captivated and thread into sealed wells. 14-gage steel construction prevents cracking and permits connections in any desired location.

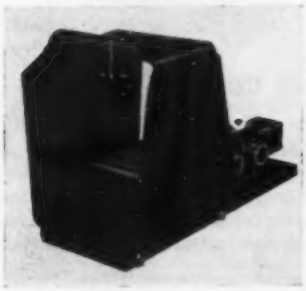
Hoffman Engineering Corp.
Anoka, Minn.

Circle 195 on Reader Service Card

FOOT GUARD

. . . prevents accidents

Features: Unit combines protection against tripping of the valve mechanism of pedal actuated control valves, with protection against injury for both operator and actuating device. Guard can be used as a sturdy, portable supporting base for control valves that cannot be secured to the floor or equipment. It



can be used unbolted, or bolted down for permanent installation. Guard base is equipped with all necessary base mounting holes, as well as threaded holes which coincide with mounting holes on all Versa valves.

Specifications: Unit weighs 8½ lbs, and heavy steel construction insures the guard will withstand abuse.

Versa Products Co., Inc.
Brooklyn, N. Y.

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Continued on next page

MARSH adds something NEW!

MARSH BEST SINCE 1900 LEATHER PACKINGS

MARSH research leads again with a new *improved* quality impregnated mechanical leather!

Marsh leads in better Leather Packings, because –

- Only packing leather specifically tanned to Marsh rigid specifications is used.
- Marsh continuing research on impregnations and quality control give you new packing material values – to improve the efficiency and acceptance of your products.

Marsh research has developed new, tougher – wear, age and extreme temperature resistant – mechanical leather packings which combine resilience and tightness with low friction.

ENGINEERING AND CONSULTING SERVICE

If you seal oil, water, air, vacuum, gas, gasoline, naptha, alcohol or other fluids, ask Marsh for field engineering service.

FEATURES: Low coefficient of friction — both static and running, greater wear resistance, tighter sealing, better high and low temperature stability, improved lubrication potentials, longer life.

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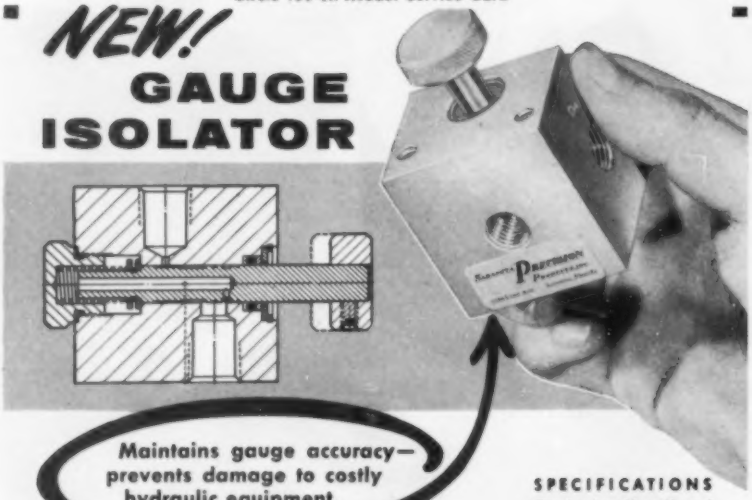
NEW!
GAUGE
ISOLATOR



Maintains gauge accuracy—
prevents damage to costly
hydraulic equipment.

■ Included in any hydraulic circuit, the new SARASOTA GAUGE ISOLATOR prevents gauge damage due to surge pressure. By maintaining correct pressure with accurate gauges, damage to hydraulic components, molds, dies, etc. is prevented. The unit is normally closed, preventing flow to the gauge. Depressing the push-button opens the gauge line to permit reading. Releasing the push-button closes the gauge line and drains the gauge to the reservoir.

SPECIFICATIONS
For hydraulic oil and many other fluids.
- 5000 psi. operating pressure — 7500 psi. proof.
- ¼" N.P.T.F. ports standard.

LIST PRICE
$14.85 F.O.B. Sarasota, Florida.

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SEND your specifications for hydraulic cylinders to American, specialists in hollow boring and honing. We manufacture from tubing or forgings in carbon or alloy steels up to 15" I.D. Over 40 years experience backed by precision machines and skilled craftsmen will save you time and money. Send your blueprints.

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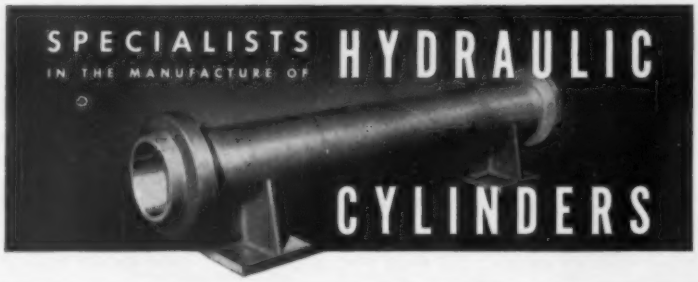


New Products continued

HYDRAULIC FILTER

. . . offers quick change

Designation: Block Quick-Top

Features: Filter head is removable in 10 seconds. Only tool reqiured is a screwdriver.

Specifications: Model 600 is low pressure, to 250 psi, at 15 to 90

gpm; model 700 is high pressure, to 5000 psi, at 15 to 90 gpm. Temperature range is —65 F to 200 F. Unit provides 10-micron filtration and uses AN-6236 elements. Special filters are made to meet requirements, and bleed and check valves and pressure drop instrumentation are available.

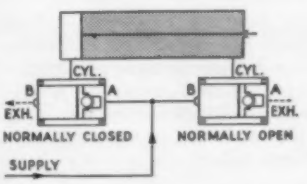
Consolidated Diesel Electric Corp.
Stamford, Conn.

Circle 197 on Reader Service Card

AIR CONTROL VALVES

. . . feature simplified piping

Design: Units feature the automatic "flow director" pilot head, which is a system of ball checks, as an integral part of both single and double-solenoid pilot control heads. Pilot



head automatically picks up pilot pressure from whichever port is used as the inlet and directs it to the pilot valve. With this design, Nopak-matic 2 and 3-way valves can be piped normally open or normally closed to pressure by simply

piping to the proper port. 4-way valves can be piped with pressure to either of two inlet ports, changing the flow pattern through the valve. The valve can thus be installed in the most accessible position without crisscross piping to the cylinder.

Specifications: Pilot heads are interchangeable on valves ¼ through ¾-in. pipe sizes. All models are subplate mounted and meet JIC standards. 2 and 3-way valves have two cylinder outlet ports; 4-way valves are available as standard with side or bottom ported subplates.

Galland-Henning Nopak Div. Milwaukee, Wis.

Circle 198 on Reader Service Card

RECIPROCATING FLUID SEAL

. . . uses rubber filling

Designation: Hallprene

Features: Here is a new variation of the familiar U-ring. A square base, synthetic rubber impregnated fabric U-ring is filled with rubber. The rubber extends in front of the lips of the seal to form a rounded nose. The two parts are bonded together to form an integral sealing

unit. Designed with slightly diverging walls, the distance across the lips is greater than across the base. The lips continue to seal, even while the pressure is too low for the ring to react. The rubber filling protects the lips from damage during handling and prevents heel distortion when under pressure. This semi-circular rubber section also insures that fluid pressure reaches all parts of the exposed surface.

Tests: A 1-in. diameter seal was fitted to the gland of a liquid spring, having a stroke of 1-in. The pressure variation from fully extended to fully closed was zero to 50,000 psi. Separation of the rubber filler from the synthetic rubber impregnated fabric did not occur until after 71,000 cycles.

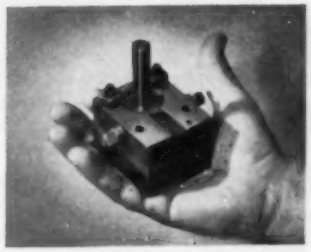
Hall & Hall Ltd. Hampton, England

Circle 199 on Reader Service Card

SMALL VOLUME PUMP

. . . for 1000 psi service

Designation: Detroit 1000



Features: This compact, hydraulic gear-type pump has rated capacity of .5 gpm at 1000 psi at 1800 rpm. Hardened steel and ball-bearing mounted bronze gears are used. Wearing surfaces are hard-chrome plated. Though initially produced for use within the reservoir, sealed adaptations for mounting externally are available.

Detroit Testing Machine Co. Detroit, Mich.

Circle 200 on Reader Service Card

Continued on next page

Make Good Design Even Better . . .

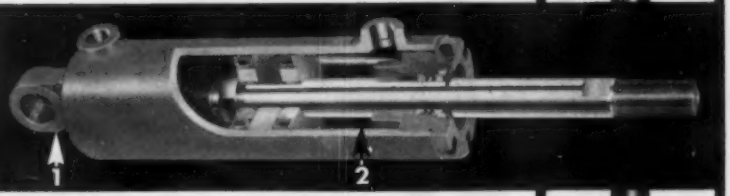
BHEW Made-to-Order HYDRAULIC CYLINDERS

Whatever your cylinder requirements, you're sure of dependable operational performance with efficient, close-tolerance BHEW cylinders that require minimum mounting space. Built to meet your specifications, their cost is reasonable; there is no charge for tooling; they are delivered on schedule.

BHEW CYLINDER FEATURES: • Standard and special designs available. • Double or single acting and telescopic. • 1½" to 8" bore. • Strokes up to 156". • Smallest possible O. D. and retracted O. A. length. • Oil cylinders with 1,500 psi or 3,000 psi working pressure, pneumatic up to 150 psi. • Cup-type, ring-type or O-ring construction. • Choice of mounting.

Double-Acting 2-piece Piston Rod Cylinder. It is excellent for extending and retracting boom arm. Both hoses are connected on rod end. →

1. Hinged mount for alignment.
2. Honed steel cylinder.



WRITE for your copy of Hydraulic Cylinder Engineering Reference Data Manual. Can save you hours of time in specifying cylinders. 40 dimensioned basic designs for general and special purpose double acting cylinders.

BHEW BENTON HARBOR ENGINEERING WORKS, Inc.

622 LANGLEY AVENUE, ST. JOSEPH, MICHIGAN

Circle 25 on Reader Service Card

New Products continued

TIME DELAY RELAY
. . . provides adjustable recycling

Designation: Model DED

Design: Adjustable recycling is accomplished by the two-way action of the DED Agastat. Because of the two timing heads, a separate time delay can be set on each to allow an adjustable "on" and "off" from 0.1 seconds to 15 minutes.

Application: Unit is useful in laboratory equipment, in operations requiring continuous automatic recycling, and in standby electrical power equipment in case of power failure.

Features: The time delay occurs in the upper portion immediately upon energization. At completion of the delay interval, a switch breaks one set of contacts and makes another. The switch remains in the

transferred position as long as the control circuit is energized. On de-energization, the unit recycles slowly, depending upon the time delay setting of the lower timing head.

Specifications: For ease of installation, double head models are equipped with front terminals. Models include dial heads to simplify time adjustments, and complete range can be accomplished with one revolution of the dial.

A'G'A Div.
Elastic Stop Nut Corp. of America
Elizabeth, N. J.

Circle 201 on Reader Service Card

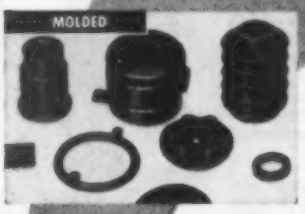
ELECTRONIC TIMER
. . . offers versatility

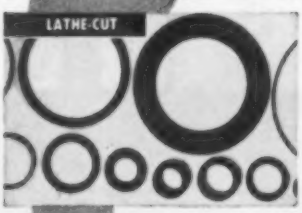
Designation: Model 120

Features: Unit combines in one timer features found in many individual timers developed for special applications, such as stop-mo-

GOSHEN
RUBBER
PARTS AND COMPONENTS

. . . from NATURAL, SYNTHETIC and SILICONE RUBBER COMPOUNDS "Custom Made" to your exact specifications by Goshen Rubber





Whether your part is of complex design, or requires materials and properties to overcome severe conditions involving high or low temperatures, fluids, gases, flexing, abrasion, or friction, put Goshen Rubber to work for you. Small parts are a specialty . . . compression or transfer molded, bonded-to-metal or precision cut . . . to critical tolerances. You'll find Goshen a reliable source, too, for O-rings of compounds meeting MIL, AMS, SAE, ASTM and industrial specifications, in MS, AN, SAE, JIC and NAS standard sizes, plus many non-standard sizes and special shapes.

We'll be glad to review and quote on your needs . . . in confidence and without obligation.

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This 8-page brochure and technical bulletins tell how you can put Goshen Rubber to work for you. Send for your free copies today!

See our catalog in Sweet's Product Design File.

PUT Goshen Rubber TO WORK FOR YOU

GOSHEN RUBBER CO., INC., 1397 S. TENTH ST., GOSHEN, IND.

Circle 64 on Reader Service Card

tion control, self-reset timing with several units in sequence, momentary start with non-repeat and self reset, sustained starting with immediate reset on opening of start switch, emergency timing-out in middle of time cycle to permit delay circuit condition, adjustable timing between fixed pulses, repeat-cycle timing. Unit has d-c starting relay to permit use of 115-volt, 25-400 cycle a-c current. Load contacts are isolated from timer and line circuits. Eight time ranges are available: 0.2, 0.5, 1.0, 3, 6, 12 or 24 seconds.

Farmer Electric Products Co., Inc.
Newton Lower Falls, Mass.

Circle 202 on Reader Service Card

CONTROL VALVES

. . . have ultra-fast response

Designation: Hi-Speed Inlines

Features: Units provide very fast response due to extremely short poppet travel. Thus these 2 and 3-way valves permit shorter ma-

chine cycle time, resulting in increased output, more accurate high-speed cut-offs, less brake and clutch slip, and faster set-up.

Specifications: Valves have only three moving parts. Air-cushioned poppet is solenoid-operated. Cast Navy-M bronze valve bodies, stainless steel moving parts, and Hycar sealing materials provide corrosion resistance. Available with integral pilots or for remote pilot operation in 2 and 3-way types, NO or NC. Working pressures range from 10 to 200 psi, in 1, 1¼ and 1½-in. NPT sizes.

Valvair Corp.
Akron, Ohio

Circle 203 on Reader Service Card

Continued on next page

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ROPER...
THIS FACT-PACKED BOOK

32 Pages of Ready Reference Including:

- **Factors on Pumping Problems**
- **Sample Problems Figured for Guidance**
- **Technical Data . . . Piping Charts**
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Plus **other information that is helpful to you**

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Rotary Pumps

GEO. D. ROPER CORPORATION
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Rockford, Illinois

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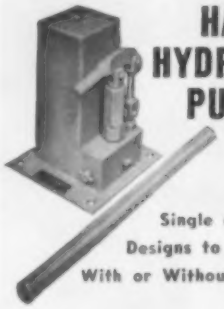
Circle 117 on Reader Service Card



HAND HYDRAULIC PUMPS

Single and Double Designs to 20,000 PSI With or Without Reservoir

160 Cubic Inch Reservoir with 8" x 8" Base Plate. Optional Size Piston: ⅜", ½", ¾", 1".

Handle length: 18 inches

Catalog No. 160

We specialize in hand pump units to operate in temperatures from minus 65F to plus 160F and with any capacity reservoirs required.

The single pump with ½" or ¾" piston now available in stainless steel.

WILLIAM S. PINE

Hydraulic Hand Pumps for 1001 Uses

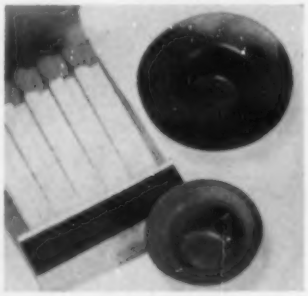
1635 E. 22nd St., Los Angeles 11, Calif.

New Products continued

MINIATURE DIAPHRAGM SEALS

. . . serve dual purpose

Design: Acting as both bellows and constant area diaphragms, the min-



iature piston seals function efficiently even in assemblies which are not perfectly aligned or machined. The seal's flange operates as a gasket, sealing mating surfaces in cylinders of two-piece design. Impregnated fabrics give long life as well as resistance to fatigue and chemical action. Operation is practically free of friction or spring gradient. Rolling action requires no lubrication and is not materially affected by cylinder or piston finish, or temper of associated parts. Seals are accurate, sensitive, and free-positioning.

Specifications: Available in cylinder bores of .94, .87, .81, .75, .69, .50 in. for wide range of applications.

Bellofram Corp.
Burlington, Mass.

Circle 204 on Reader Service Card

BALL VALVE AND UNION

. . . in one unit

Designation: Union-Ball

Features: With the use of this valve, the necessity of a separate union to provide a breaking point in the line is eliminated. In-line maintenance is also possible by removing four bolts, lifting the cen-

TRU-O-SEAL TEFLON SEAL

STOPS PIPE THREAD LEAKS

PAT. PENDING

Satisfaction Guaranteed Or Money Back TRIAL OFFER

TRU-O-SEAL Fittings are guaranteed to seal pipe thread connections permanently against all oils, practically all known chemicals and gases; to seal under high pressures or vacuum; to withstand —280° to plus 500° F.; to eliminate "overtightening" damage and pipe dope. Available in ⅛" to 2½" pipe thread sizes.

$10.00 Trial Offer No. 1: eight ⅛", ten ¼", eight ⅜", ten ½" pipe thread TRU-O-SEAL Fittings.

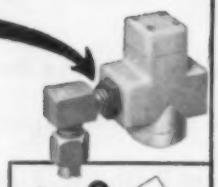
$10.00 Trial Offer No. 2: eight ½", ten ¾", four 1" pipe thread TRU-O-SEAL Fittings.

Send order to

TRU-O-SEAL DIVISION Flick-Reedy Corporation

2008 N. Hawthorne • Melrose Park, Ill.

"Miller Fluid Power" is also a Div. of Flick-Reedy Corp.


1
Thread TRU-O-SEAL on pipe or fitting (no messy pipe "dope" needed).
SEAL SIDE
2
Thread pipe or fitting 4 threads into port. Point in desired direction.
3
Tighten TRU-O-SEAL to complete leakproof assembly (only light torque required).

REPUBLIC **VALVES**

INDUSTRIAL • CHEMICAL • AIRCRAFT

NEEDLE AND GLOBE TYPES WITH J.I.C. AND AN STANDARD TUBE ENDS

OFFSET GLOBE VALVE

High pressure needle and globe valves by Republic have forged bodies for super duty service—brass, steel, aluminum alloy, or stainless steel. Exclusive design features. Pipe, or AN or J.I.C. tube ends, or combinations, sizes ⅛" to 2". Operating range up to 5,000 psi, –65° to 350°F.

Manufacturers also of high quality low and hy-pressure check valves, relief, 2, 3, and 4-way plug valves, and special valves to specifications.

Write for complete new catalog No. 654A. Distributors in principal cities coast to coast.

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RM REPUBLIC MANUFACTURING CO.

15655 BROOKPARK ROAD • CLEVELAND 11, OHIO

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Circle 125 on Reader Service Card

ter section from the line, and making necessary replacements. With the opening in the ball and seat rings maintaining the same shape as the inside of the pipe, resistance to flow is reduced to a minimum. Operation is unaffected by reversal of flow since the ball is fitted with

twin seals, one on either side. The metal components of this valve may be of bronze, aluminum-bronze, or aluminum with carbon steel. Seat and seals are available in Buna-N, hypalon, neoprene, natural rubber and Teflon.

Worcester Valve Co., Inc.
Worcester, Mass.

Circle 205 on Reader Service Card

HYDRAULIC PANELS

. . . assemble to any size

Designation: Pan-Sec

Features: Units permit building any size master panel in multiples of six inches. Panel sections bolt together easily and quickly. Any standard gasket-mounted air or hydraulic valves can be used.

Specifications: Available in three standard sizes: 6 x 6, 6 x 12 and 12 x 12-in. Ribbed butting surfaces are machined to precision tolerances.

Birmingham Hydraulic Products
Detroit, Mich.

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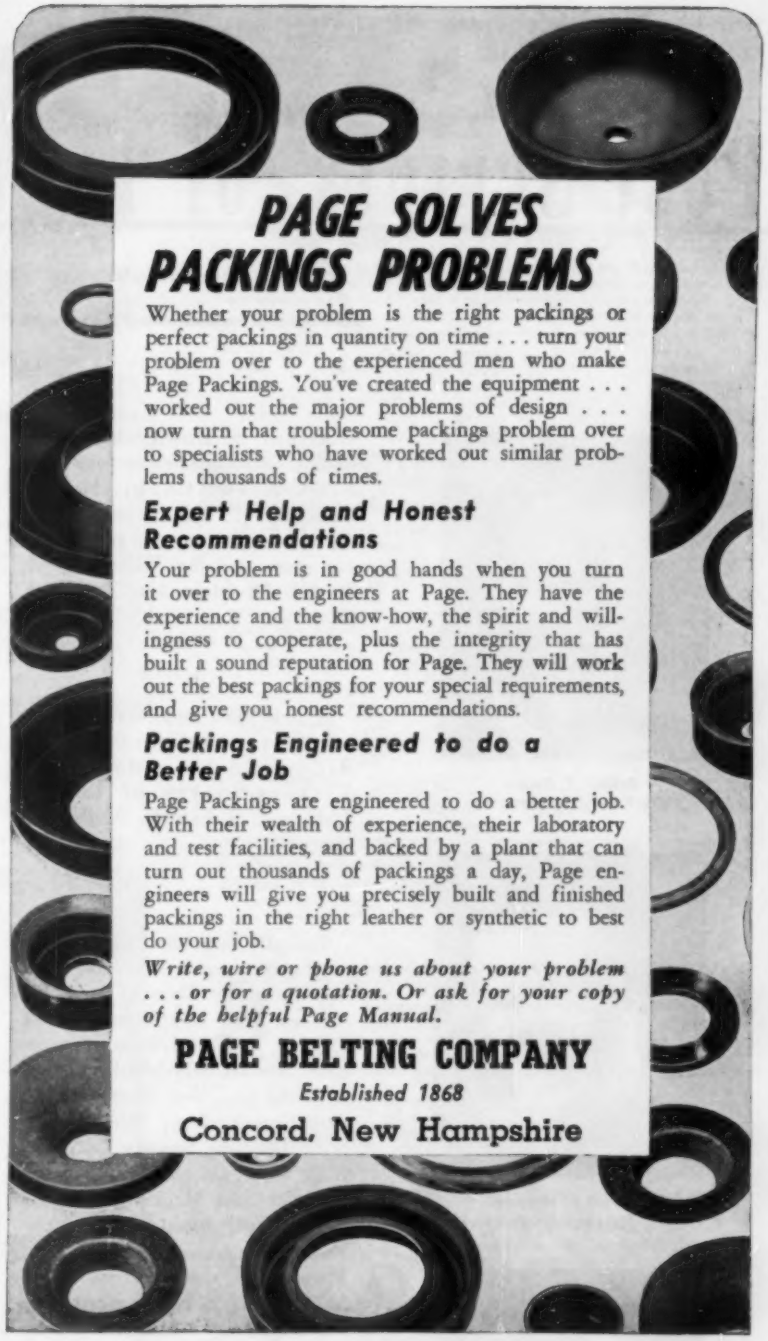
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Post Scripts of Industry

News about people, manufacturers and sales organizations

Arthur S. Down
Flick-Reedy Corporation

Robert E. Walker
Vickers-Sperry of Canada Ltd.

R. W. Selvig
Helicoid Gage Div.
American Chain & Cable Co., Inc.

Arthur S. Down was named eastern division sales manager for **Flick-Reedy Corp.**, Melrose Park, Ill. He will be responsible for sales in the eastern and southern states for the **Miller Fluid Power Division** and **Tru-Seal Division.**

A new sales and service office has been established at 3365 Ridgewood Ave., Montreal by **Vickers-Sperry of Canada Ltd.**, with **Robert E. Walker** in charge.

Recently appointed distributors of the Blackhawk line have been announced by **Dynex Inc.**, Pewaukee, Wis. Distributors in the Eastern and Mid-Western areas are: **Air & Hydraulic Engineering Co.**, New Haven, Conn.; **Colliflower, Inc.**, Ellicott City, Md.; **Lincoln Supply Co.**, Boston, Worcester, and Pawtucket. **Airoyal Co.**, Maplewood, N. J.; **Scott Equipment Co.**, Cincinnati, Columbus, and Dayton; **Pneu-Hydraulics, Inc.**, Cleveland; **Airline Equipment Co.**, Philadelphia; **Weinman Pump & Supply Co.**, Pittsburgh.

R. W. Selvig was made sales representative for the New York and New Jersey territory of the **Helicoid Gage Div., American Chain & Cable Co., Inc.**, Bridgeport, Conn. Selvig will headquarter at 230 Park Ave., New York City.

Louis E. Dondero has been named manager of the West Allis plant of the **Le Roi Div., Westinghouse Air Brake Co.**, Milwaukee. He joined Le Roi in 1946 as assistant service manager and for the past 17 months has been manager of their Cleveland Rock Drill plant.

James A. Ruck has been named field representative by **Republic Rubber Div., Lee Rubber & Tire Corp.**, Youngstown, Ohio. Smith will headquarter in Republic's district office at 549 W. Washington Blvd., Chicago.

Marrick Co., Inc., 1152 Bardstown Rd., Louisville, Ky. was appointed exclusive sales representatives in Kentucky and southern Indiana for **Tuthill Pump Co.**, Chicago.

Automatic Switch Co., Florham Park, N. J. announced the appointment of three new distributors for the Asco line. They are: **John N. Fehlinger Co., Inc.**, New York; **Western Machinery Co.**, Portland, Ore.; and **Leighton Stone Corp.**, San Francisco.

Republic Mfg. Co., Cleveland, has appointed **Nix Industrial Supply Co.**, 2702 South High St., Oklahoma City, as a stocking distributor.

Continued on page 186

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Eliminate Costly Flow Failures

Magnatrol
SOLENOID VALVES

Quick Operating *Non Sticking* *Tight Seating*

These three design advantages are your assurance against costly flow failures. Attain dependable, accurate, automatic or remote control of liquids or gases with **Magnatrol Valves.** Installed quickly and easily in connection with . . . flow-meters, thermostats, float and time switches. **Every Magnatrol Valve is delivered to you—factory tested—guaranteed free from defects in material and workmanship.**

Available in normally closed or normally open models. Pressure ranges from zero up to 300 PSI. Voltages to 575.

Catalog containing complete specifications mailed upon request.

Magnatrol VALVE Corp.
HAWTHORNE 21
NEW JERSEY

2567

COMPRESSED AIR SEPARATOR • FILTER • TRAP
MURPHY TRIUMPH AA

Installed near point of use, it separates and ejects moisture automatically, then filters out all scale, rust or other impurities and delivers air clean and dry; **of instrument quality.**

Write now for **FREE** Data Sheet No. 2567.

JAMCO

JAS. A. MURPHY & CO., INC.
1417 EAST HIGH STREET, HAMILTON, OHIO

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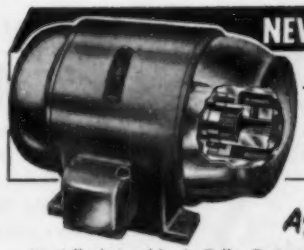


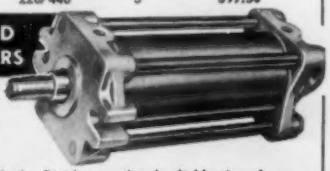
NEW! PALLEY SPECIAL
SAVE on
ELECTRIC HYDRAULIC PUMP MOTORS
1 and 3 Phase, 60 Cycle AC 220/440V, 115/230V.
3/4 to 15 HORSEPOWER

AS LOW AS 99.50

Specially designed by the Palley Engineering staff with the cooperation of a leading manufacturer of Electric Motors. These Pump Motors are built to our own exacting specs and designed to couple directly to all types of aircraft hydraulic pumps. Built to continuous duty with high starting torque and are drip-proof. See examples listed below. Many others in stock! Send for Catalog.

Part No.	H.P.	R.P.M.	Voltage	Phase	Price each
H-SM1	3/4	1800	115/230	1	$ 99.50
H-SM2	1	1800	115/230	1	127.50
H-SM5	2	3600	220/440	3	149.50
H-SM13	10	3600	220/440	3	319.50
H-SM15	15	3600	220/440	3	399.50

Special Palley TIE ROD OIL or AIR CYLINDERS



150 PSI AIR or 750 PSI OIL on 2", 3", 4" & 5" BORES

150 PSI AIR or 500 PSI OIL on 6" & 8" BORES

Built to our own exacting standards. Rigid, rugged and reliable tie-rod construction. Hard-chromed piston rods. Built-in durability that keeps them working day after day with a minimum of "down" time. Dual mounting. Pivot base. Flanged head. Superb quality at typical Palley Savings. See examples below.

Part No.	Bore	Stroke	Thrust at 150 PSI (Air)	Thrust at 750 PSI (Oil)	Price
200-4	2"	4"	470 lbs.	2350 lbs.	$27.50
200-16	2"	16"	470 lbs.	2350 lbs.	36.90
300-6	3"	6"	1060 lbs.	5300 lbs.	34.50
300-36	3"	36"	1060 lbs.	5300 lbs.	59.05
400-12	4"	12"	1885 lbs.	9425 lbs.	49.50
500-4	5"	4"	2950 lbs.	14,725 lbs.	69.90
600-8	6"	8"	4250 lbs.	14,150 lbs.	116.85
800-12	8"	12"	7540 lbs.	25,100 lbs.	190.30

SPECIAL GOVERNMENT SURPLUS BARGAINS

2000 PSI HYD. CYLINDER

Genuine top quality Gov't Surplus. Used but excellent condition. Has a Bore of 2-1/4", Shaft 1", Stroke 4", Eye-to-eye lgth. 13½". Ports 1/4" AN.

SPECIAL Only 12.75

STRATO-POWER HYD. PUMP

Positive displacement, piston type pump. Has a built-in variable flow control valve. Capacity is 2.4 GPM at 1800 RPM. Maximum cont. operating pressure 1400 PSI. Max. operating speed 3750 RPM. Rotates in either direction. Has 1" internal pipe ports. **27.50**

VICKERS HYD. ANGLE PUMPS

Made to top aircraft specs. Will fit pump motors above.

Cat. No.	GPM	PSI	RPM	Price
H-P4A	5.3	1000	3000	$22.50*
H-P5A	2.7	1500	3000	25.75*
H-P4U	6	1000	3000	22.50*

*Used but excellent condition.

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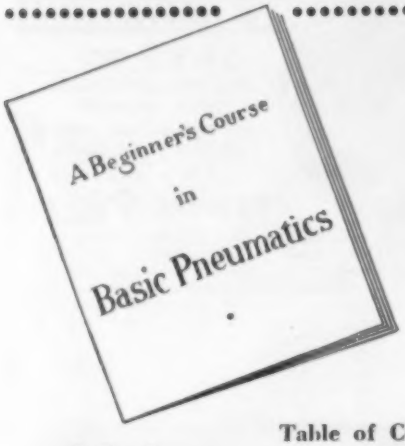

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With A FLUID CONTROLS

Pick off a regulated flow from the main pump to operate an attachment, feed circuit, control system, power steering, or table lift.

- Considerable savings in space, and money
- Long trouble-free service
- Available in ¼" thru 1" pipe sizes

Write or phone Mentor, Ohio, Blackburn 5-2625 for complete specifications.

Fluid Controls, inc.

Member of NFPA

Manufacturers of Hydraulic Valves and Devices
Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

1284 N. CENTER STREET • MENTOR, OHIO

Post Scripts of Industry
continued

Neff Engineering Co., Fort Wayne, announced the establishment of a branch office in Evansville. They now have offices at South Bend, Fort Wayne, Indianapolis and Evansville.

Van Products Co., Erie, Pa. announced the appointment of **Vincent Q. Rapp** as general manager and **Dana B. Griffin** as sales manager. Both men have considerable experience in the pneumatic products field.

Vincent Q. Rapp
Van Products Company

Baldwin Instrument Co. Ltd. in England has been acquired by the **Harper Group of Companies.** Baldwin will continue to operate as a separate company.

Due to increased production, **Plessey Hydraulics** has set up a new plant near Swindon, England to handle their export business.

Fluid Controls, Inc., Mentor, Ohio announced that the **Walter A. Rankin Co.,** Drexel Hill, Pa. is their new representative in that area.

Stanley M. Proctor Co., Cleveland, announced the appointment of **Randall M. Campbell** as sales engineer. Campbell has had five years experience in sales, including an extensive background in hydraulics and pneumatics.

A new 11,000-sq-ft addition has been completed by **Ajax Flexible Coupling Co.,** Westfield, N.Y. This new plant gives a total of 32,000 sq ft of manufacturing space equipped with latest-type production machinery.

Ralph W. Deemer has been appointed factory manager and **J. Paul Mathews,** manager of development and research, at **Republic Rubber Div., Lee Rubber & Tire Corp,** Youngstown. Both positions are newly created.

Young Radiator Co., Racine, has appointed **Flournoy & Everett, Inc.,** Downey, Calif. engineering, sales and service representatives for Young shell-and-tube heat exchanger products in southern Calif.

J. E. Dilworth Co., Memphis, Tenn. has been appointed special representative for **Racine Hydraulics & Machinery Inc.,** Racine, Wis. They will sell Racine products in western Tennessee, Arkansas, and northern Miss.

R. E. Murray has been named sales engineer by **Weinman Pump & Supply Co.,** Pittsburgh. He was formerly with Stanley Berg, Inc., and Loganport Machine Co.

R. E. Murray
Weinman Pump & Supply Co.

John Spotton Co. Ltd., Toronto, Can. has appointed **Andrew M. Damer** as sales manager.

Edward C. Wagner has been appointed to the post of assistant to the vice president, engineering, **Ford Instrument Co. Div., Sperry Rand Corp. Michael A. Moscarello** was named engineering director for marine equipment. The company also announced the addition of 100,000 sq ft of space in a fourth bldg. at 3300 Northern Blvd., Long Island City in a move to boost manufacturing capabilities.

C. R. Dernbach has been appointed sales manager for the **Trombetta Solenoid Corp.,** Milwaukee. Dernbach has been with Allis Chalmers Mfg. Co., and Grote Mfg. Co.

Flodar Corp. appointed **C. L. Thompson Co.,** 4417 West Lisbon St., Milwaukee, as Flodar distributor for Wisconsin.

Continued on next page

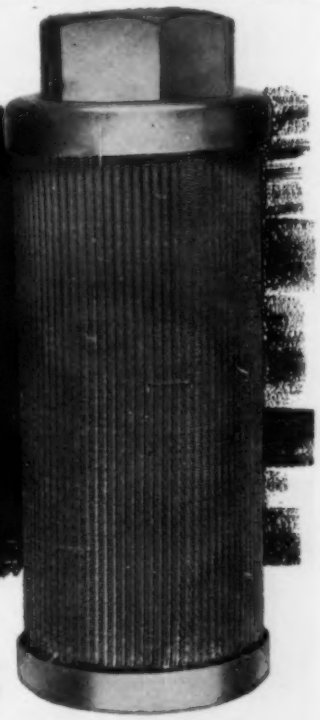
Capital

HYDRAULIC OIL FILTER

with

Monel Metal Insert

Reservoir Type for Hydraulic and Oil Re-circulating Machinery



EASY TO INSTALL—EASY TO CLEAN
LONG LIFE—LOW COST—SIZES AND SCREENS TO FIT YOUR NEEDS

★ ONLY THREE PARTS
★ MEETS J.I.C. STANDARDS
★ GREATER FILTERING AREA
★ SPECIAL TRAP-WEAVE MESH

Specially woven MONEL wire cloth and a new method of compact corrugation, gives triple protection with less space than other filters of like capacity. Trap-weave mesh stops thin, elongated particles with NO loss of efficiency.

Non-corrosive, non-toxic materials throughout. Easily cleaned with an ordinary brush.

Write for descriptive circular.

CAPITAL ENGINEERING & MFG. CORP.

5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

Circle 29 on Reader Service Card

Post Scripts of Industry
continued

Appointment of **R. Bruce Foster** as chief application engineer has been announced by **Sundstrand-Denver Div., Sundstrand Machine Tool Co.,** Rockford, Ill. He will be surveying and developing market areas in aircraft and allied fields for the Denver designing and manufacturing facilities.

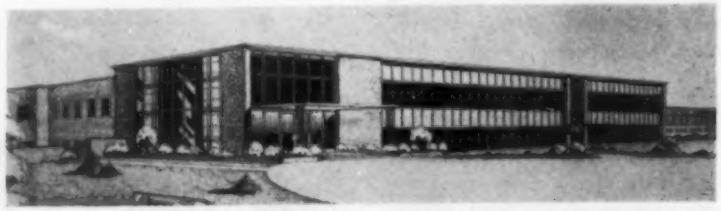
Atlas Valve Co., Newark, named **Willard L. Umstadter** sales representative for the southern New Jersey territory. He will maintain headquarters at Point Pleasant, N. J.

Brosey Engineering Co., Indianapolis, has been appointed Indiana representative for **Ledeen Manufacturing Co.,** El Monte, Calif.

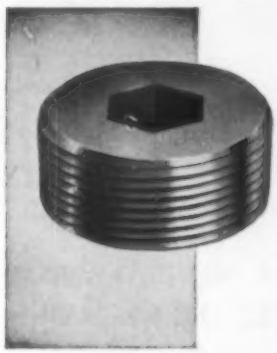
Howard E. Andersen, Jr. has been promoted to district manager of **Minnesota Rubber & Gasket Co.** Cleveland office at 5559 Pearl Rd., Cleveland.

Sargent Engineering Corp. has expanded its plant facilities in Huntington Park, Calif. to meet increasing demands for its products.

Frank Hribar, Jr. has rejoined **The Pacquin Co.,** Cleveland, as manager of their aircraft division.



Superior Tube Co., Norristown, Pa., has authorized construction of a new office building and factory addition at its general offices and main plant, 17 miles northwest of Philadelphia. Cost of construction, equipment and furnishings will be about two million dollars. The expansion will provide space to consolidate and simplify production lines and to house increased engineering, laboratory and office personnel. It will be constructed of aluminum, steel, glass, concrete, tile and colored porcelain enamel panels. Ground for the new buildings will be broken late this year. Construction will be completed in late 1958.



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UNBRAKO®

Dryseal-Thread Pressure Plugs

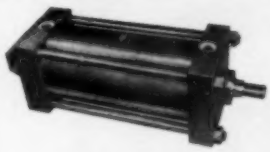
Use them in place of ordinary pipe plugs, or wherever liquids and gases must be contained under pressure. UNBRAKOs seal without compound. They are made of the same high strength alloy steels, have fully formed threads and the same internal wrenching feature as other UNBRAKO socket screws. Standard sizes—1/16" to 1¼"—are stocked by authorized industrial distributors. Ask your UNBRAKO supplier for Bulletin 883. Or write STANDARD PRESSED STEEL CO., Jenkintown 2, Pa.

STANDARD PRESSED STEEL CO.

UNBRAKO SOCKET SCREW DIVISION SPS JENKINTOWN PENNSYLVANIA

Modernair HEAVY DUTY CYLINDERS

for Air or Hydraulic Service



Developed to meet the need for a rugged, reliable cylinder, for heavy mill-type service, MODERNAIR's new Heavy Duty Series are made in two types:

HA • for air service to 200 psi.

HH • for hydraulic service to 1,000 psi.

Both types are available in 3¼", 4", 5", 6" bore sizes, optional stroke length.

Features include:

★ Rolled steel heads
★ Extra-heavy tie rods
★ Heat-treated, chrome plated piston rods
★ Self-adjusting "Uneepac" rod seals
★ Needle valve cushion adjustment

Write for catalog, prices today—or phone your local MODERNAIR distributor (listed on your phone book Yellow Pages).

Modernair CORPORATION

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Member National Fluid Power Association 31

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Gardner-Denver Co., Quincy, Ill., announced the election of three new vice presidents. Elected were **George W. Gutekunst, C. H. Rieman** and **Brice D. Maddox.** Gutekunst continues as general sales manager, Rieman is general manager of the Denver plant, and Maddox is general manager of the Keller Tool Div.

Unit Manufacturing Co. has moved to 18 West 26th St., Minneapolis. The new location increased production facilities and made available additional area for research and development work.

Jack Neun, formerly with Ross Operating Valve Co., Detroit, has joined their northwest distributor, **Hydraulic & Air Equipment Co.,** Portland, Ore. Neun will manage expanded operations in Seattle.

Parker Appliance Co., Cleveland, has promoted **O. O. Royer** to assistant general sales manager. In the engineering department, **Robert W. Phillips** became staff engineer, **John E. Szitar, Jr.,**

O. O. Royer
Parker Appliance Co.

special project engineer, and **Robert G. Rasmussen** was appointed to the technical service staff. **Donald H. Voelker** was appointed special sales engineer for the industrial hydraulics division. **Sturgis Equipment Co.,** 601 S. Taylor Ave., St. Louis 10, Mo. was appointed as distributor for eastern Missouri and southern Illinois.

Continued on next page

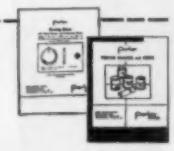
Prove by comparison tests that Parker O-rings seal better, last longer

Comparison tests will prove it. You can't *see* the difference. You can't *feel* it. But in *use,* Parker O-rings seal better, last longer.

Why? Because Parker O-rings are precision-molded of superior compounds developed by exhaustive research and experimentation. Our engineering service will help with your problems — whether in gland design or compound. From Parker, you get the *right* O-ring for your *specific* application.

These trouble-free, leakproof seals are carefully evaluated for elongation, tensile strength, compression set ratings, resistance to oils, fuels, chemicals and temperature extremes. Exacting laboratory and service tests make sure that Parker O-rings meet applicable specifications. Whatever your requirements, Parker can supply the O-rings you need.

Parker O-Lube is especially formulated for O-ring lubrication requirements. It comes in a handy, squeeze-tube container.



RUBBER PRODUCTS DIVISION, Section 526-B,
The Parker Appliance Company,
17325 Euclid Avenue,
Cleveland 12, Ohio.
1538 South Eastern Ave.,
Los Angeles, Cal.

Please send:

☐ O-ring Size Catalog No. 5701
☐ O-Lube Catalog No. 5840

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COMPANY_____
ADDRESS_____
CITY_____STATE_____

Parker
Hydraulic and fluid system components

Post Scripts of Industry
continued

Nathaniel Brewer was promoted to vice president in charge of technology and chairman of the executive committee of **Fischer and Porter,** Hatboro, Pa. **Alexander Greenfield** is the new director of research, development and engineering.

Airaterra, Glendale, Calif. has named **Don Butler** a technical representative. He was formerly west coast manager, Special Products Div., Quaker-Pioneer Rubber Co. They also announced the appointment of **Larry Garrett** to the engineering department of the company.

James F. Bentley was named to the sales staff of the Air-Hydraulic Division, **R. C. Neal Co., Inc.,** Buffalo.

A. D. Charboneau has joined **Hydro-Line Mfg. Co.,** Rockford, Ill. He will work with the Detroit engineering staff, and help designers and builders in the metal-working, processing, construction, and similar industries.

Charles E. Huddleston was made director of engineering at **Lewis Welding & Engineering Corp.,** Cleveland. He was formerly engineering manager of the Arms and Ammunition Div., Olin Mathieson Chemical Corp.

Hydraulic Accessories Corp., Van Dyke, Mich., has formed a hydraulic valve division, located at their Hoover Rd. plant. A national sales organization is being set up under **Tom King,** national sales manager.

Brown & Sharpe Mfg. Co., Providence, R. I., has announced these changes: New England—Machine tool and industrial products sales offices have been opened at 65 Auburn St., Auburn, Mass., with **Herbert Richardson** as district sales manager, machine tools, and **Russell O. Newton,** district sales manager, industrial products. Ohio—Machine tool and industrial products sales offices, formerly in Cincinnati, have been consolidated at 1577 West 17th St., Cleveland, now sales headquarters for the two divisions. District

Russell O. Newton
Brown & Sharpe Mfg. Co.

AUTO-DIESEL GAPLESS PISTON RINGS

will give you The GREATEST POSSIBLE COMPRESSION

Pat. No. 2,738,243

1. REDUCES AIR OR OIL LEAKAGE.
2. LOWERS THE COST OF COMPRESSED AIR.
3. YOU GET A MORE POSITIVE STROKE.

The patented insert assures these 3 important advantages not found in any other ring. This should have your serious consideration for any pneumatic application. They can be adapted for high temperatures by changing the insert. They can be made a contracting ring for sealing shafts, bearings or replacing packings, etc., and many other applications.

Will STOP -- Blow Bys

Can be used as original or replacement in pneumatic operated industrial equipment and for normal pressure hydraulic. The patented feature assures a positive seal without a chance of blow bys—this results in the greatest possible compression. Made in sizes from 2" and up. It will pay to investigate.

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Write for Details

THE AUTO-DIESEL PISTON RING CO.
3137 Superior Avenue • Cleveland 14, Ohio
"RINGS and SHAPES Since 1921"

IMMEDIATE DELIVERY

contour cutters for popular hydraulic ports!

One pass completes all operations necessary to produce the port contour. Job time cut as much as ⅔! All have carbide cutting edges for long life, smooth finishes. Available in all sizes. Write for prices.

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California

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sales managers are **W. H. Stewart,** machine tools, and **F. L. Pritchard,** industrial products. West Coast—Sales have been divisionalized, and district sales office is at 3040 E. Olympic Blvd., Los Angeles. District sales managers are **John A. Rinek,** machine tools, and **Vernon L. Wade,** industrial products.

F. L. Pritchard
Brown & Sharpe Mfg. Co.

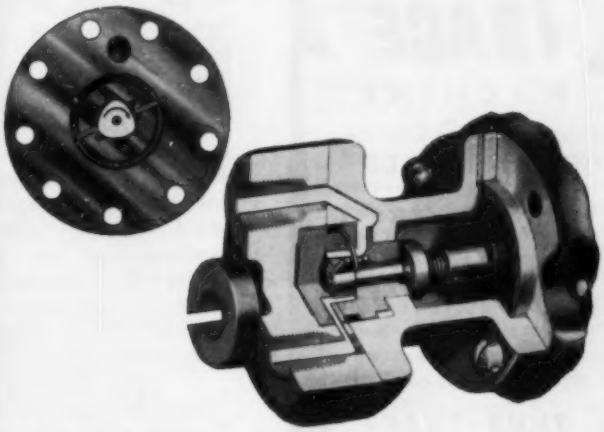
Vernon L. Wade
Brown & Sharpe Mfg. Co.

Flexonics Corp., Maywood, Ill., is building a new plant on a 10-acre site in Santa Ana, Calif. The company's western regional office, headquarters for far-western sales, field engineering, and service organization, will move to the Santa Ana plant as soon as the facility is completed. Heading up the new division is **Kenneth Kampenga** as factory manager, with **George W. Derum** as western regional sales manager, **Leroy Fessler,** chief design engineer, **L. W. Lewandowski,** manager of assembly and warehousing operations, **Wm. S. Fortner,** office manager, **Don R. Anthes,** manager of accounting and price estimating, and **Ralph Schuring,** plant engineer.

WELDON

FLUID METERING PUMPS

Positive Displacement Rotor Type. For Industrial Applications, Aircraft Anti-Icing and Aircraft Fuel.



IT'S SO SIMPLE!

The rotation of the rotor draws the fluid in through two passages, filling the cavities formed by the three lobes of the rotor. This fluid is sealed within these small cavities until it is forced through the two outlet holes by the floating blades. The flow may be kept uniformly divided through two outlet ports, or may be combined internally for passage through a single port.

Compact • Light Weight

Send for Weldon Manual and Catalog with detailed specifications and installation drawings, covering the full range of Weldon pumps in various capacities. Specify your requirements.

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TRUE-TRACE
MACHINE TOOL CONTROLS

Send for new 24 page catalogue

Greater production and increased profits thru 1, 2 and 3 slide control hydraulic tracers and numerical controls.

TRUE-TRACE SALES CORP.

El Monte 18, Calif.

Post Scripts of Industry — continued

Jamesbury Corp. moved into new modern quarters at 45 New St., Worcester, Mass. The new plant provides five times more floor space than the firm had, and is located in a building specially constructed for their operation. Plant personnel will be doubled, and considerable new production equipment will be added. They also announced the appointment of the **George T. Metcalf Co.** to handle a new sales promotion and advertising program.

Neff Engineering Co., Fort Wayne, Ind., has appointed **Ralph Brendel** as sales engineer in charge of its new Evansville branch, with offices in the Ross Theater Bldg., 2509 Washington Ave.

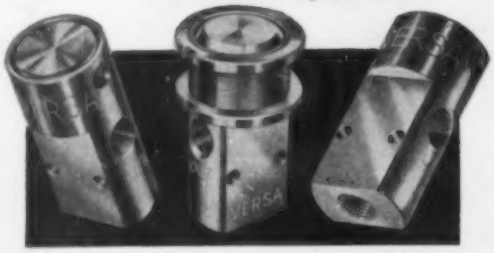
Richard J. Mitchell was appointed sales manager of the Marine and Ordnance Dept., **Vickers Incorporated,** Detroit.

Richard J. Mitchell
Vickers Inc.

Norman D. Ingersol has been named field engineer for the **Weatherhead Industrial Dis-**

Versa "A" Valves

Give MAXIMUM Capacity In MINIMUM Space...



- Versa solves the space problem with a truly economic valve.
- The overall size of the Versa "A" valve is only 2" high by 1" in diameter, yet it has the capacity of much larger valves.
- Ideal for controlling cylinders, instruments and larger pilot valves.
- Available in ⅛" NPT in 2-way & 3-way types with or without button guard, in either normally open or closed models.
- Simple to mount on equipment or can be furnished for panel mounting.
- Prices range from $4.00 to $6.50 each.

For complete information write today for Folder #14S.

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FREE CATALOG! Write today for your free copy of Versa's Catalog #14.

Prevent PULSATION Positively!

with BURGESS-MANNING SNUBBERS

Burgess-Manning Pulsation Snubbers are products of 20 years of specialization—and engineered to your specific piping pulsation problem. They eliminate the cause of your trouble at the source with resulting improved equipment efficiency, increased production, reduced maintenance and elimination of operating hazards.

BURGESS-MANNING COMPANY
769 East Park Avenue, Libertyville, Illinois
Dallas, Texas

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Circle 28 on Reader Service Card

tributor Div., Weatherhead Co., Fort Wayne. A resident of Marin Co., Calif., his territory will include northern Calif., Nevada, Utah, and Colo. The company also announced the appointments of **Reginald C. Grimm** and **Craig H. Edwards** to the west coast sales engineering staff of the Aviation Division. They have their headquarters in Glendale, Calif.

The Hydraulic Division of **Pantex Mfg. Corp.,** Pawtucket, R. I., has appointed **Russell Associates,** Brightwaters, L. I., N. Y. distributor of all the company's airborne hydraulic components.

Ross Engineering, Chicago, Ill., has been appointed exclusive sales and engineering representative in northern Illinois for **Kahn & Co., Inc.,** Hartford, Conn.

Everett S. Hoff has been appointed manager, Summerill Stainless Tube Div., and **E. Joseph Miller** was promoted to sales manager, Summerill Tubing Co. Div., according to **Columbia Steel & Shafting Co.,** Pittsburgh. Hoff was most recently sales manager of the Summerill Tube Div.

Denison Engineering Div., American Brake Shoe Co., Columbus, Ohio, has announced the appointment of **William F. Bohannan** as field research engineer.

William F. Bohannan
Denison Engineering Div.
American Brake Shoe Co.

Dean J. Deakyne has been made sales engineer for **Parker Appliance Co.,** Cleveland. He is assigned to the metropolitan New York, Conn. area. Parker also announced the appointment of **James C. DuBois** as sales engineer. DuBois will headquarter in Toledo, to cover a new district consisting of northwestern Ohio plus the adjoining counties in Mich. **Persinger Supply Co.,** Williamson, W. Va. was named distributor of reusable hose and tube fittings for mining equipment hydraulic systems. **Norman Engineering Co.,** Chicago is a new distributor for the Parker line of O rings and accumulators.

Kalamazoo Div., New York Air Brake Co., Kalamazoo, Mich. has appointed **Barker Rockford Co.** as distributors in northern Illinois, eastern Iowa and southern Wisconsin. Barker Rockford is located at 110 Cedar St., Rockford, Ill., and operates in the Chicago area as **Mid-West Hydraulics Division,** 203 Madison St., Oak Park, Ill.

SPRING LOADED
This Ring
has Everything!
Fall
"CJ"
WIPER RING
CLOSED JOINT
Here's the ring that gets all the dirt . . . wipes the piston rod CLEAN with every stroke—leaves no tattle-tale streak because it has no open joint.
Spring-Loaded, it has "Squeeze Grip Action," assuring new ring performance . . . automatically takes up the wear. Dry-Lapped at the factory, its wiper edge assures true circle contact . . . Seals Out dirt and even liquids when certain of our rubber seal features are added to the metal portion of ring.
SEALS OUT
SQUEEZE GRIP ACTION
Be sure to specify FALL Wiper Rings. FALL "CJ" Wiper Rings with the closed joint. Available in bronze, stainless steel, cast iron in sizes from 3/16" to 13" dia. If you have a wiper ring problem get in touch with us.
All Fall Rings covered by patents issued or patents pending.
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Toledo 1, Ohio Phone Cherry 3-6513
Fall Wiper Ring SPRING LOADED
You Can Depend on ACE PRODUCTS —Established 1935!

Engineers do better at
BENDIX PRODUCTS DIVISION

SENIOR HYDRAULICS ENGINEER

Opportunity immediately available in the Hydraulics Group in the Aircraft Landing Gear Department with an engineering organization which is a pioneer and leader in Aircraft and Automotive components. Located in a progressive, medium-sized community. Graduate work, with Bendix financial assistance, can be done at the University of Notre Dame. Reasonable housing. No commuting.

Expanding activity in this newly organized section is concerned with anti-skids, nose wheel steering systems, brake valves and hydraulic and pneumatic equipment associated with landing gear systems. This involves the complete design analysis for performance, cost, weight, stress and recommending changes for product improvement.

Engineer must have a minimum of five years' experience with a degree in Mechanical or Engineering Mechanics. Hydraulics experience, preferably in Aircraft, concerned with product design experience, data analysis or product improvement desirable.

Send a summary of your educational and engineering background to:

J. L. Breslin
Technical Employment
Bendix Products Division
804 Bendix Drive • South Bend, Ind.

The broader the base the brighter the future

It just makes good sense—the range of job opportunities is far wider and advancement opportunities greater with a company operating on the sound basis of diversified engineering and manufacturing.

THE MARKET PLACE

When replying to a box number in the Market Place, address your letter to Applied Hydraulics, 812 Huron Road, Cleveland 15, Ohio. Attention: Box No.

SALES—ENGINEERING REPS AVAILABLE EAST COAST

Top-flight sales organization with 30 years experience covering aircraft, missile, and industrial fields seeks product lines in fluid systems, mechanical components and electromechanical accessories. Write to Box 1957 APPLIED HYDRAULICS.

AN HARDWARE & FITTINGS

Stainless, Aluminum, Brass, Steel. All sizes—immediate delivery from world's largest shelf stock. Buy direct from manufacturer. Lower prices—quicker service. Send for free wall charts showing complete line of AN Fittings.

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9050 Washington Blvd.,
Culver City, California

Distributors Wanted

Distributors wanted for patented Metallic Rod Wipers. The Seal Guard is standard equipment on several makes of pneumatic and hydraulic cylinders. We have a national distribution program in progress with several exclusive territories open. Submit resume of lines carried, territory covered and experience in the hydraulic and pneumatic field. See our ad on page 172 of this issue.
Mail replies to: HYDRAULIC ACCESSORIES COMPANY, 24301 Hoover Road, Van Dyke, (Detroit), Michigan. Attention Mr. T. W. King Sales Manager.

Classified Advertising Rates: Cost of Position Wanted Ad is $10.00 for the first inch, each additional line 90 cents. Cost of all other classified ads is $20.00 for the first inch and $15.00 for each additional inch or fraction thereof. Rates for Display Ads in this section will be sent on request.

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SALARY OPEN

B. S. in Mechanical Engineering or equivalent and minimum of 3 years responsible experience in functional and environmental testing.

Call or write:
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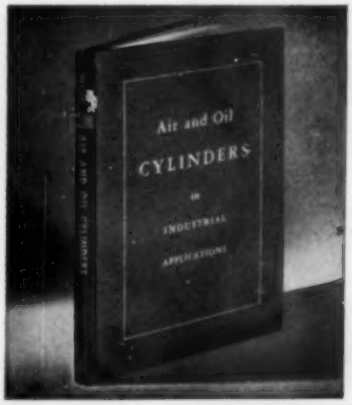
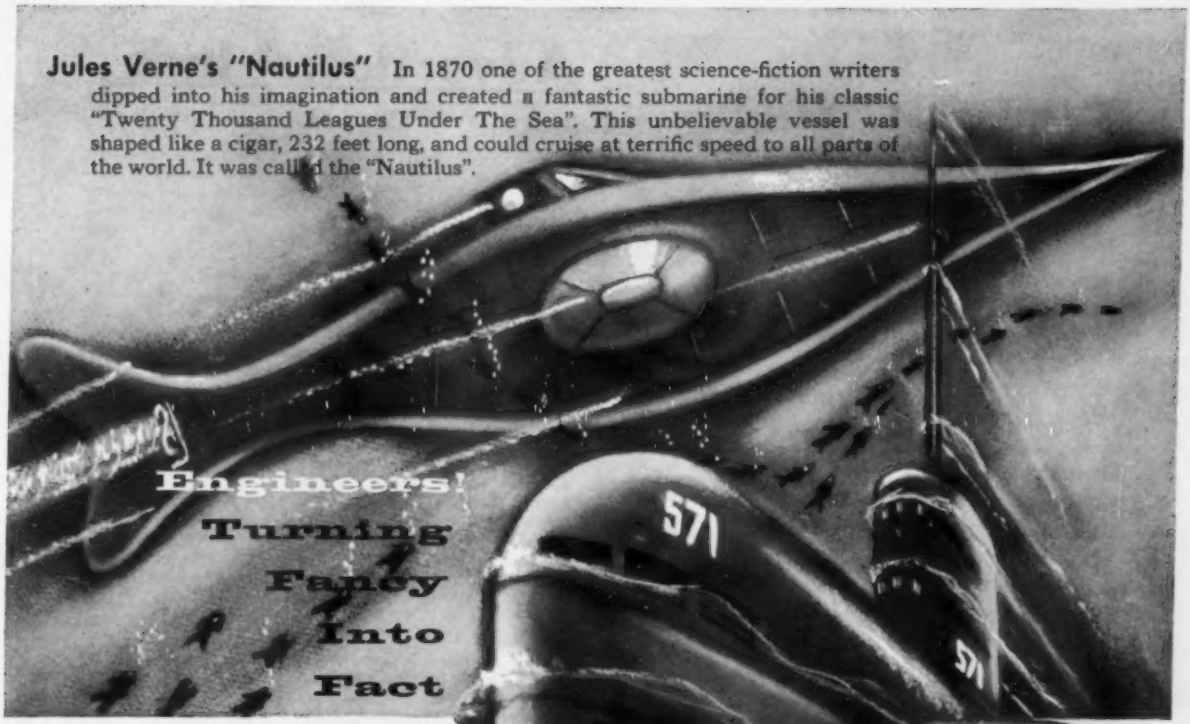


Elmer Heiser has written this valuable cylinder handbook which tells about types, cushions, how to order, proper porting, correct sizing, packings, and efficient installation methods.

It's full of application ideas.

PRICE $5.00

The Industrial Publishing Corporation
812 Huron Road • Cleveland 15, Ohio


Jules Verne's "Nautilus" In 1870 one of the greatest science-fiction writers dipped into his imagination and created a fantastic submarine for his classic "Twenty Thousand Leagues Under The Sea". This unbelievable vessel was shaped like a cigar, 232 feet long, and could cruise at terrific speed to all parts of the world. It was called the "Nautilus".

Engineers! Turning Fancy Into Fact Is A Westinghouse Tradition

85 years later, Westinghouse actually turned this thrilling fancy into fact. On January 17, 1955 a modern "Nautilus" cruised down Connecticut's Thames River into Long Island Sound to start her sea trials. Powered by a history making nuclear engine, its exploits surpassed even the creation of Jules Verne's prolific imagination. For the first time controlled nuclear fission had successfully provided the motive power for a vehicle or vessel.

U.S.S. Nautilus

Powered by the "S2W" Atomic Engine, created and built by Westinghouse.

ENGINEERS — ***Westinghouse is now engaged in building the world's first atomic powered fleet. If your background includes pump, valve, or arrangments experience, join our atomic team in this historic undertaking.***

Submit your resume to:
Mr. John D. Batey

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ELECTRIC CORP.

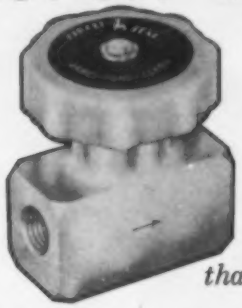
First in Atomic Power

Dept. M-16, **P.O. Box 1047, Pittsburgh 30, Pa.**

Circle 36 on Reader Service Card

a manual

SHUT-OFF VALVE



that doesn't leak

- "O" Ring seal for dead tight shut-off
- Liquid or gas service to 3000 psi
- 303 stainless barstock body
- Design permits throttling

This valve can also be furnished with a toggle handle and is available in 1/4 inch female pipe size and 3/8 inch female tube size. It may be serviced ("O" Rings replaced) without removing from the line. This 900 series valve, incorporating an "O" Ring seal, is not dependent on a metal to metal seat thus eliminating gauling or scoring and assuring extremely long cycle life with ZERO LEAKAGE.

CIRCLE SEAL PRODUCTS COMPANY, INC.
2181 EAST FOOTHILL BLVD. • PASADENA 8, CALIF.

TRU-FLATE®

BLOW GUNS

- **Model No. 400** Button Type Blow Gun—Nickel Aluminum Casting with ¼" Female Pipe Thread, Molded to fit the hand. New type leakproof valve. Long Extension Nozzle included.

Model No. 400

- **Model No. 401** Thumb Lever Blow Gun—Aluminum Casting with Nickel Plated Parts ¼" Female Pipe Thread. New Non-adjustable leakproof valve. Furnished with two Tips for "Spot" or "Fan" Air Spray.

- **Model No. 410** Blo-Dri Gun—Adapted for Industrial or Automotive use. Can be controlled from a mere breath to a large blast. It can deliver *five times* the air volume of an ordinary blow gun. The additional air is drawn in through the large openings on the sides. Special Spray Attachment and Hose included.

Write for Catalog today.

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September, 1957

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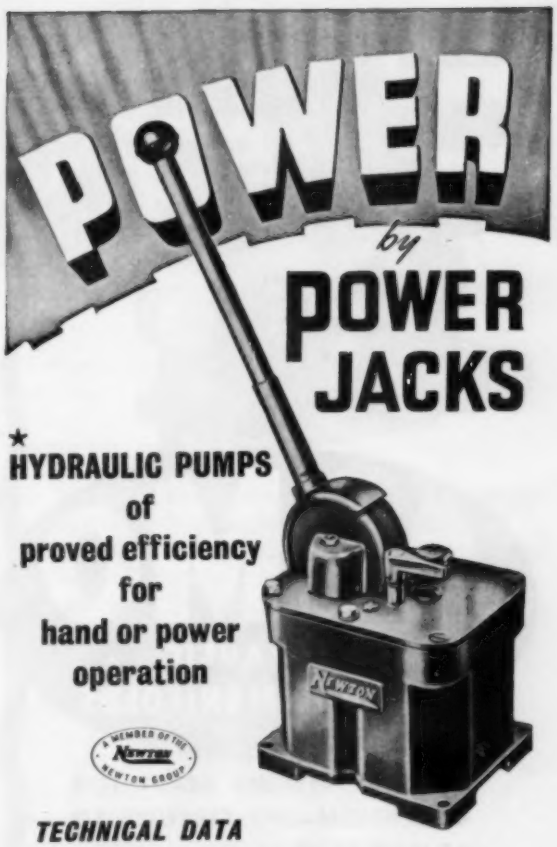

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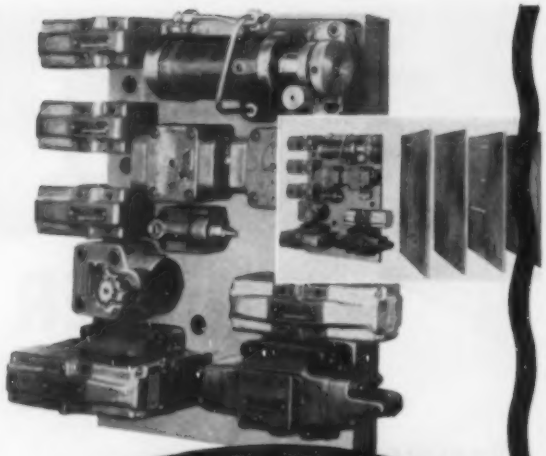

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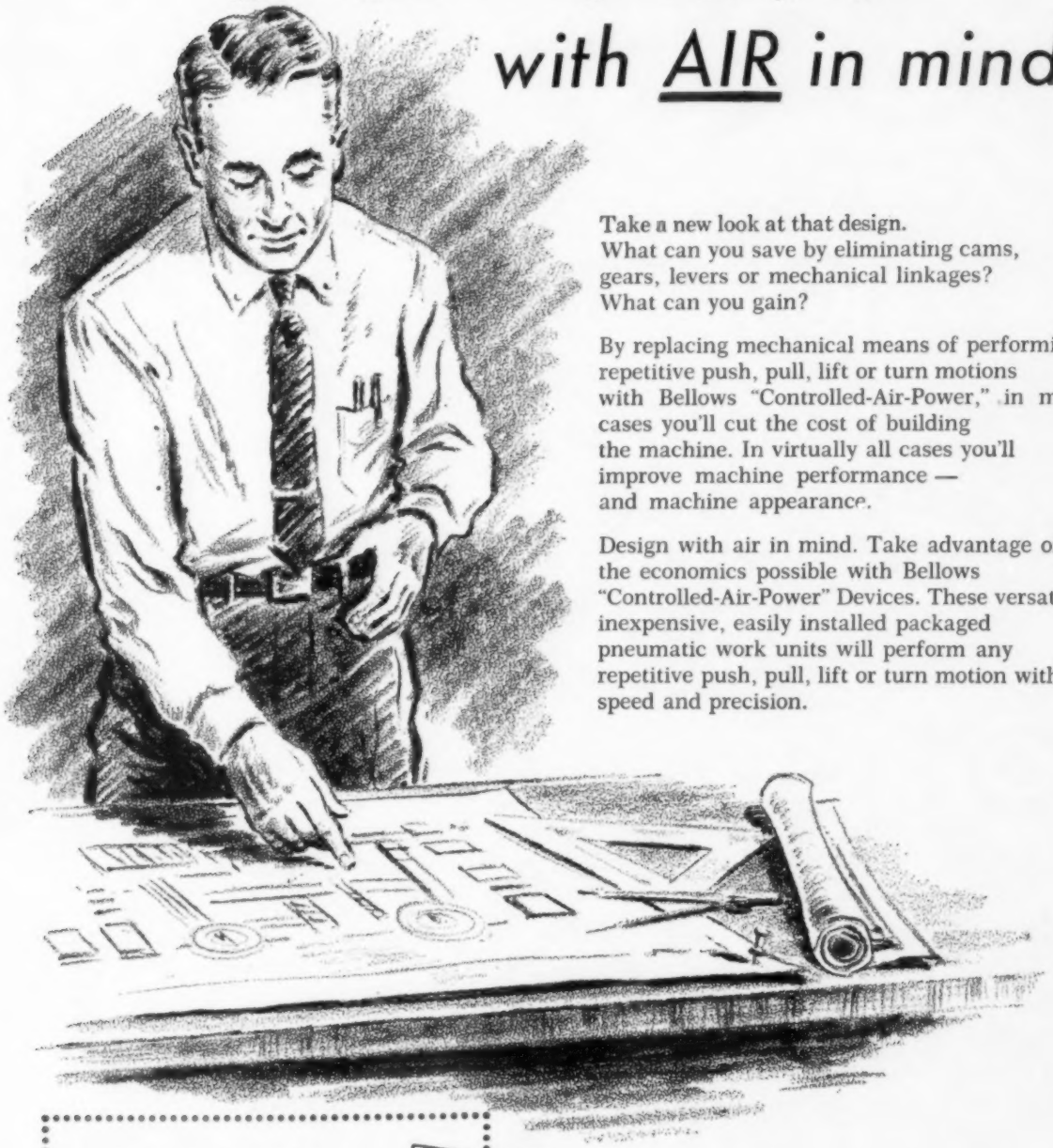

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